ASTM BULLETIN

FEBRUARY 1954

Number 196

Telephone: Rittenhouse 6-5315 Cable Address: Testing, Philadelphia

Biggest Committee Week Held in Washington 5

Proposed Method of Test for Measuring the Static Coefficient of Friction of Waxed Floor Surfaces 20

Proposed Method of Test for Measuring the Dynamic Coefficient of Friction of Waxed Floor Surfaces 21

Mechanical Mixing in Compressive Strength Test of Cement Mortar Proposed 24

Three Years' Outdoor Weather Aging of Plastics Under Various Climatological Conditions by S. E. Yustein, R. R. Winans, and H. J. Stark 29

Improved Scale System for Stiffness Testing Machine by H. LaTour and R. S. Sutton 40

A Tension Impact Test for Sheet Metals by C. W. Muhlenbruch 43

Machine to Apply Repeated Loads to Large Flexural Members by A. Roesli, A. C. Loewer, and W. J. Eney 50

Experiences with Ultrasonic Reflectoscope Inspection of Main Seam Welds of Seven Large Spheres by L. Tarr 54

Discussion of Paper on Analytical Study of the Die-Casting Process 61

IN THE SOCIETY

Actions on Standards 7

Publications
Marburg Lecture; Book of Standards Supplements 8

Chicago Host to 57th Annual Meeting 10

1953 Financial Report 12

Richart Award Established 14

Schedule of ASTM Meetings 14

Toward Better Presentation of Papers 16

Personals 65

New Members 68

Deaths 68

GENERAL NEWS NOTES

The National Research Council 18

Unsolved Problems 19

The Bookshelf 26

News Notes on Laboratory Supplies and Testing Equipment 70

Calendar of Other Societies' Events 80

Index to Advertisers 83

ASTM Bulletin is indexed regularly by Engineering Index, Inc.

The Society is not responsible, as a body, for the statements and opinions advanced in this publication.

ASTM Bulletin, February 1954. Published eight times a year, January, February, April, May, July, September, October, and December, by the American Society for Testing Materials. Publication Office—20th and Northampton Sts., Easton, Pa. Editorial and advertising offices at the headquarters of the Society, 1916 Race St., Philadelphia 3, Pa. Subscriptions, United States and possessions, one year, $2.75; two years, $4.75; three years, $6.50; Canada, one year, $3.25; two years, $5.75; three years, $8.00. Other countries, one year, $3.75; two years, $6.75; three years, $9.50. Single Copies—50 cents. Number 196. Entered as second class matter, April 8, 1940, at the post office at Easton, Pa., under the act of March 3, 1879.

Copyrighted, 1954, by the American Society for Testing Materials.

Reg. U. S. Pat. Off.

Raymond E. Hess
Editor

George A. Wilson
Assistant Editor

Virginia Burkhart
Editorial Assistant

Sheldon E. Fitterer
Advertising

OFFICERS

Board of Directors

President

L. C. Beard, Jr.

Vice-Presidents

N. L. Mochel C. H. Fellows

Directors

Term ending 1954	*Term ending 1955*
J. W. Bolton	G. R. Gohn
R. A. Schatzel	W. H. Lutz
E. O. Slater	H. K. Nason
Stanton Walker	A. O. Schaefer
F. P. Zimmerli	M. A. Swayze

Term ending 1956

N. A. Fowler
R. T. Kropf
T. F. Olt
J. R. Townsend
K. B. Woods

Past-Presidents

L. J. Markwardt T. S. Fuller
H. L. Maxwell

Executive Secretary

R. J. Painter

COMMITTEE ON PAPERS AND PUBLICATIONS

This committee has authority in all matters affecting the acceptance, rejection, editing and publication of papers, committee reports, and discussions. The committee also acts in an advisory capacity to the Board of Directors in publication matters in general.

R. E. Hess, *Chairman*

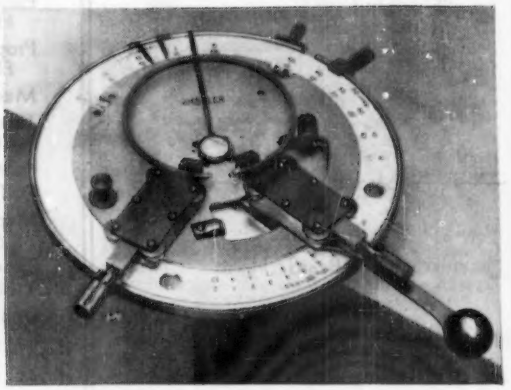
T. J. Dolan	F. L. LaQue
G. R. Gohn	L. S. Reid
L. E. Gregg	M. Van Loo
S. S. Kurtz	L. W. Wood

L. L. Wyman

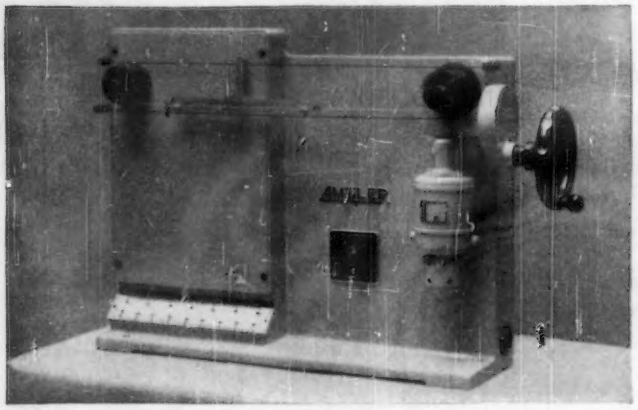
Correspondent Members from Pacific Coast District

F. J. Converse R. E. Davis

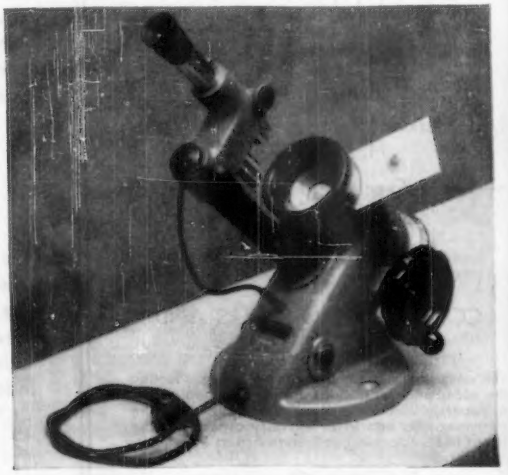
AMSLER TESTING EQUIPMENT



THE PISTON RING TESTER measures the force required to open or close the ring and operates practically without friction. The bending moment is distributed over the entire circumference of the ring. A simple formula converts to lateral pressure against the cylinder wall. The instrument may be used to determine the maximum bending moment at fracture. It can accommodate rings from 2 to 6 inches diameter and has 5 ranges of 10, 20, 50, 100 and 200 inch pounds.



THE SMALL TENSILE TESTER is designed to accommodate wires, twine, thread, narrow ribbons, etc. of small tensile strength. Four ranges of 10, 20, 40 and 60 pounds are provided on the smallest model. A 100 pound and a 120 pound model are also available. The sample is wound around drums, one of which is the axis of the dependable pendulum measuring system. The other drum can be rotated by hand or motor drive. The gripping length is 18 inches. Extensometers of the simple or magnifying type are available.



THE PAINT AND VARNISH TESTER makes a cup impression on a sheet of metal which has been painted with the material being tested. The depth of the cup before the coating cracks and the size and shape of the fissures are indicative of some of the qualities of the paint. The sample is held in a die and a plunger pressed into it from below by turning the handwheel. A dial indicates the height of the cup. A microscope provides for examination of the progress of the test.

The New Amsler Temperature Controller will also be in operation

Amsler offers testing machines for tension, compression, torsion, shear, transverse, fatigue, cold bend, hardness, wear, calibration, gauge, creep, pressure, ductility, impact, volume and micro tests.

Adolph I. Buehler

OPTICAL INSTRUMENTS

2120 GREENWOOD AVENUE, EVANSTON, ILLINOIS

ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 196 FEBRUARY, 1954

Society's Biggest Committee Week Held in Washington

Meetings of 43 Main Committees Bring Activities to All-Time High

BREAKING all previous Committee Week records of the Society for attendance and number of committee meetings held, ASTM'S February 1–5 meetings at the Hotel Shoreham in Washington attracted 1400 members, committee members, and guests, and provided facilities for 427 committee and subcommittee meetings. (A list of the 43 main committees which met appears in the accompanying box.)

The purpose of Committee Week is the saving of time and expense afforded the members by the concentration of committee meetings in one time and place. The meetings held during Committee Week provide an opportunity for completion of new and revised standards in the committees prior to the annual meeting in June. For the most part, these new and revised specifications and methods will be acted on at that meeting although some may be approved prior to that time through the Administrative Committee on Standards.

Complete summaries of the technical committee meetings held during Committee Week will appear in the April issue of the ASTM BULLETIN.

Dinner Guests Hear Assistant Defense Secretary Thomas

In this busy week, many men and women found time to relax at the Washington District's cocktail party and dinner and to hear C. S. Thomas, Assistant Secretary of Defense (Logistics and Supply) speak on the organization of the Department of Defense, some of its problems, and the programs to solve these problems. Mr. Thomas presented a highly interesting and instructive picture of the logistics and supply responsibilities with which he is concerned as one of nine Assistant Secretaries of Defense. The unusually large number of complimentary remarks indicated the favorable reaction from the audience of about 200, to both Mr. Thomas' talk and to this type of non-technical program.

A-3 on Cast Iron
A-5 on Corrosion of Iron and Steel
A-7 on Malleable Iron Castings
A-10 on Iron-Chromium, Iron-Chromium-Nickel Alloys
B-1 on Wires for Electrical Conductors
B-2 on Non-Ferrous Metals and Alloys
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-5 on Copper and Copper Alloys, Cast and Wrought
B-6 on Die Cast Metals and Alloys
B-7 on Light Metals and Alloys Cast and Wrought
B-8 on Electrodeposited Metallic Coatings
C-1 on Cement
C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements
C-3 on Chemical-Resistant Mortars
C-7 on Lime
C-8 on Refractories
C-9 on Concrete and Concrete Aggregates
C-11 on Gypsum
C-12 on Mortars for Unit Masonry
C-15 on Manufactured Masonry Units
C-16 on Thermal Insulating Materials
C-18 on Natural Building Stones
C-19 on Structural Sandwich Constructions
C-22 on Porcelain Enamel
D-1 on Paint, Varnish, Lacquers
D-3 on Gaseous Fuels
D-4 on Road and Paving Materials
D-5 on Coal and Coke
D-8 on Bituminous Waterproofing and Roofing Materials
D-11 on Rubber and Rubber-Like Materials
D-16 on Industrial Aromatic Hydrocarbons and Related Materials
D-19 on Industrial Water
D-21 on Wax Polishes
D-22 on Methods of Atmospheric Sampling and Analysis
E-1 on Methods of Testing (Subcommittees and Sections)
E-4 on Metallography
E-5 on Fire Tests of Materials and Construction
E-7 on Non-Destructive Testing
E-9 on Fatigue
E-10 on Radioactive Isotopes
E-11 on Quality Control
E-12 on Appearance
Joint Committee on Paint, Varnish and Lacquer

E. F. Kelley, Chief, Physical Research Branch, Bureau of Public Roads, Chairman of the Washington ASTM District Council, was an excellent toastmaster. Guests and ASTM officers at the speaker's table, in addition to Messrs. Thomas and Kelley, were:

D. A. Quarles, Assistant Secretary of Defense for Research and Development
E. F. Mansure, Administrator, General Services Administration
A. V. Astin, Director, National Bureau of Standards
Captain C. A. Blick, Head of Materials Control Division, Office of Naval Material, Department of the Navy
Colonel Billy Cornett, Chief Domestic Standards, Directorate of Requirements, Department of the Air Force
Colonel W. W. Milner, Chief, Standards Branch, Procurement Division Department of the Army, Office of the Assistant Chief of Staff, G-4, Logistics
Clifton E. Mack, Commissioner, Federal Supply Service, General Services Administration
Floyd T. Hague, Office of Assistant Secretary of Defense (Application Engineering)
Willis S. McLeod, Director, Standards Division, Federal Supply Service, General Services Administration
E. H. Weaver, Assistant Director of Materials, Office of Defense Mobilization
Commander W. H. Howe, Chairman, Navy Standardization Committee, U. S. Navy
ASTM President L. C. Beard, Jr., Assistant Director, Socony-Vacuum Labs., Socony-Vacuum Oil Co., Inc.
ASTM Senior Vice-President N. L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia
Fred Burggraf, Director, Highway Research Board, National Research Council, Washington; Vice-Chairman ASTM Washington District Council
J. R. Dwyer, National Bureau of Standards; Secretary, ASTM Washington District Council
E. W. Bauman, National Slag Ass'n., Chairman, Arrangements Committee, Washington District Council
ASTM Executive Secretary, R. J. Painter
ASTM Associate Executive Secretary, R. E. Hess

Hold Two Symposiums

The two other highlights of the week were the Symposium on Design of Experiments and the Symposium on Color of Translucent Products.

The Symposium on Design of Experiments, sponsored by Committee E-11 on Quality Control of Materials, was held Tuesday evening, February 2. It was enthusiastically received by more than 250 in attendance. These papers, listed below, will not be published, but Dr. W. J. Youden, author of one of the papers and chairman of Symposium Committee is preparing an extensive abstract of this symposium which will appear in a forthcoming issue of the BULLETIN.

The Purpose of Experimental Data—W. G. Cochran, Johns Hopkins University.

An Engineering Application of Experimental Design—Besse B. Day, and F. R. Del Priori, Naval Experimental Station.

Design of Experiments and Physical Sciences—W. J. Youden, National Bureau of Standards.

Symposium on Color of Translucent Products, sponsored by Committee E-12 on Appearance required two sessions, morning and afternoon of Wednesday, February 3. In the seven papers, listed below, the speakers reviewed color measurement and control techniques in industries in which color of transparent and translucent materials is important. They pointed out the uneveness in the development of methods among industries and the inadequacies, limitations, and unsolved problems that occur. They emphasized the dollar value of these problems, underlining the need for adequate financing of research programs and proof that these costs are justified.

These papers, in which were represented the glass, naval stores, plastics, brewing, paints, foods, color styling, oils, and dairy products industries, will be published later as an ASTM *STP*.

The Color of Petroleum Products—H. M. Hancock and J. J. Wright, The Atlantic Refining Co.

A Color Space for Color Grading Purposes—G. W. Ingle, Monsanto Chemical.

Color Problems in Glass Products—A. J. Werner, Corning Glass.

Color in the Brewing Industry—Irwin Stone, Wallerstein Laboratories.

Color Problems in Sugar Clarifinate—R. A. McGinnis, Spreckels Sugar.

Color Grading of Agricultural Products—Wilbur Gould, Ohio State University.

Color Problems in Transparent Surface Coatings

Color in Dairy Products—Mark Keeney, University of Maryland.

Summary and Open Discussion—Deane B. Judd, moderator.

ASTM Standards Used in Maintenance Manual

IN past issues of the BULLETIN articles have appeared illustrating the use of ASTM Standards. Members will recall the story in the December, 1953, issue of how James A. Murray, Massachusetts Institute of Technology used ASTM standards in his new laboratory manual for students.

The Aluminum Company of America also has a new manual—quite a different one, however.

Because maintenance of power equipment plays such a vital role in its operations, the company felt that satisfactory use and maintenance of insulating oils and lubricants, which are part and parcel of its power equipment, are equally vital. The company has therefore developed suitable procedures for treating these power system oils. These methods have been thoroughly tested under a wide variety of heavy and light duty operating conditions over a period of many years. The results obtained have thoroughly established the effectiveness and values of these methods. Up to now the company has used the methods incorporated in the manual in only a few of its various plants but soon the program, implemented by the manual, will be extended to all plants. The manual gives complete and detailed instructions regarding the results and operation of a well-rounded and service-proved program for power system oil maintenance.

Of its three chapters, the first describes in detail the various sampling and testing procedures used in determining the condition of used and reclaimed oil. In the majority of instances, *both sampling and testing methods follow the ASTM Standard procedures.*

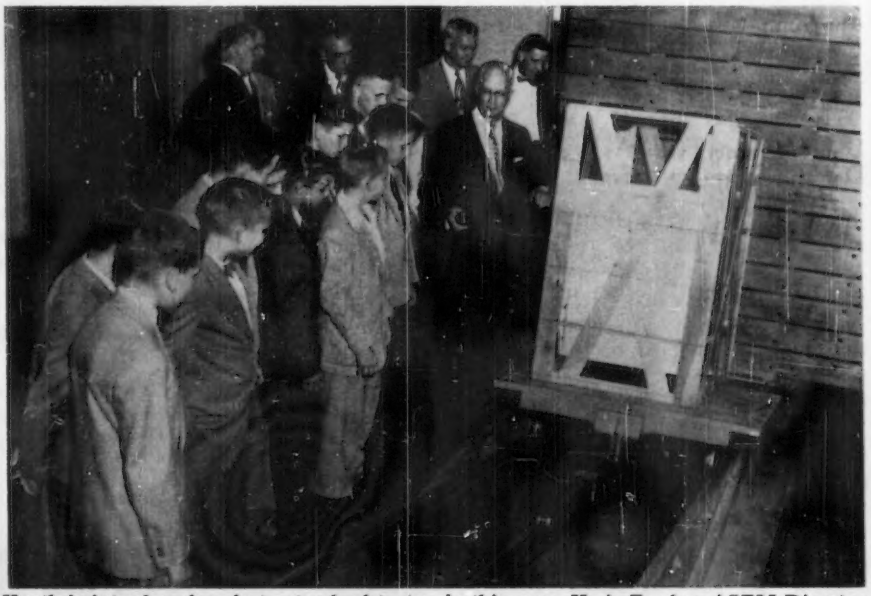
Sampling Methods used in the Manual are from ASTM D 117. The a-c dielectric strength test used is also from ASTM D 117. Neutralization Number (ASTM D 663), moisture test (ASTM D 117 and D 95), viscosity (D 88 and D 445), Pour Point (D 97), Flash Point (D 92), and Steam Emulsion (D 157) are all described in Chapter I.

Chapter II covers the general philosophy of preventive maintenance, discusses transformer (used and old) maintenance, and describes procedures for new transformers and oils. In this chapter small transformers, conservators, gas-over-oil transformers, thermosyphon by-pass treaters, and transformer and storage tank breathers are also given a comprehensive treatment.

Bushing and circuit breaker oil maintenance are covered as are hydroelectric powerhouse oils. The data and records needed for a successful maintenance program are described and illustrated.

The third chapter is devoted to a discussion of fundamentals affecting and controlling performance characteristics of electrical insulating oils, hydraulic pressure system oil, and lubricating oil. A section is devoted to a discussion of oil oxidation and deterioration by-products.

Here is an instance where ASTM standards have been used by one of the nation's great manufacturers in a program which will save many thousands of dollars a year.



Youth is introduced early to standard tests—in this case, N. A. Fowler, ASTM Director, and Director of Sale and Research, General Box Co., is demonstrating the incline plane impact test for shipping containers, ASTM D 880 – 50. The occasion of this demonstration was an open house held by his company celebrating the winning of the Des Plaines, Ill., Pony League baseball championship by the team sponsored by General Box.

January Actions of ASTM Administrative Committee on Standards

Latest Recommendations Pertain to Steel, Concrete Pipe, Thermal Insulating Materials, and Ceramic Whiteware

THE Administrative Committee on Standards on January 13, 1954, accepted several new tentative methods and specifications, and tentative revisions of existing standards and tentatives recommended by ASTM Committees A-1 on Steel, C-13 on Concrete Pipe, C-16 on Thermal Insulating Materials, and C-21 on Ceramic Whitewares.

Significance of these recommendations is summarized briefly below. A listing of the actions taken appears in the accompanying box.

Steel

Twelve boiler and pressure vessel plate specifications were revised by Committee A-1, establishing ladle and check analysis ranges for silicon, chromium, nickel, molybdenum, vanadium, and manganese when specified as a range. Specifications affected by this change are:

Open-Hearth Iron Plates of Flange Quality (A 129)
Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels (A 201)
Chromium-Manganese-Silicon (CMS) Alloy-Steel Plates for Boilers and Other Pressure Vessels (A 202)
Nickel-Steel Plates for Boilers and Other Pressure Vessels (A 203)
Molybdenum-Steel Plates for Boilers and Other Pressure Vessels (A 204)
High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 212)
Manganese-Vanadium Steel Plates for Boilers and Other Pressure Vessels (A 225)
Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 in. and Under in Thickness) (A 285)
High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 299)
Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 301)
Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 302)
Low-Carbon High-Nickel Steel Plate for Pressure Vessels (A 353)

Concrete Pipe

A group of tentative revisions, most of which are common to the Standard Specifications on the following four types of concrete pipe, were approved:

Specifications for Concrete Sewer Pipe (C 14)
Reinforced Concrete Sewer Pipe (C 75)
Reinforced Concrete Culvert Pipe (C 76)
Concrete Irrigation Pipe (C 118)

These changes further improve and refine the requirements and techniques of testing, based on accumulated experience and long use of these well-known and nationally recognized standards.

The revisions include provision for lift holes; the use of drilled cores in place of rodded cylinders; extension of permeability test beyond 15 min and not to exceed 24 hr; provision in the tables for nonreinforced concrete sewer pipe to contain value for extra strength pipe, as well as to recognize the use of tongue and groove type; and refinements in the three-edge bearing test procedure.

Actions Taken by Administrative Committee on Standards, January 13, 1954

New Tentatives

Methods of:

Chemical Analysis of Whiteware Clays (C 323 – 53 T)

Specifications for:

Diatomaceous Earth Block Thermal Insulation (C 333 – 54 T)
Diatomaceous Earth Thermal Pipe Insulation (C 334 – 54 T)

Tentative Revisions of Standards

Specifications for:

Concrete Sewer Pipe (C 14 – 54)
Reinforced Concrete Sewer Pipe (C 75 – 54 T)
Reinforced Concrete Culvert Pipe (C 76 – 54 T)
Concrete Irrigation Pipe (C 118 – 54 T)

Revisions of Tentatives

Specifications for:

Open-Hearth Iron Plates of Flange Quality (A 129 – 54 T)
Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels (A 201 – 54 T)
Chromium - Manganese - Silicon (CMS) Alloy-Steel Plates for Boilers and Other Pressure Vessels (A 202 – 54 T)
Nickel-Steel Plates for Boilers and Other Pressure Vessels (A 203 – 54 T)
Molybdenum-Steel Plates for Boilers and Other Pressure Vessels (A 204 – 54 T)
High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 212 – 54 T)
Manganese-Vanadium Steel Plates for Boilers and Other Pressure Vessels (A 225 – 54 T)
Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 in. and Under in Thickness) (A 285 – 54 T)
High Tensile Strength Carbon-Manganese-Silicon Steel Plates for Boilers and Other Pressure Vessels (A 299 – 54 T)
Chromium-Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 301 – 54 T)
Manganese - Molybdenum Steel Plates for Boilers and Other Pressure Vessels (A 302 – 54 T)
Low-Carbon High-Nickel Steel Plate for Pressure Vessels (A 353 – 54 T)

Thermal Insulating Materials

Committee C-16 has prepared two new specifications for Diatomaceous Earth Block Thermal Insulation (C333) and Diatomaceous Earth Thermal Pipe Insulation (C 334). There are no specifications covering these products other than Federal Specifications and the committee felt that industry's requirements are better represented in the proposed specifications than in the Federal Specifications.

Both specifications cover material intended for use on surfaces operating at temperatures up to approximately 1900 F as well as to material intended for use at temperatures up to 1500 F. The specified material is composed predominately of diatomaceous earth uniformly mixed with mineral fiber and with heat-resistant inorganic binder.

Ceramic Whiteware

In preparing Tentative Method of Chemical Analysis of Whiteware Clays (C 323) Committee C-21 has endeavored to meet the industry's long standing demand for such a method that could find general acceptance in the field. This has been accomplished by the committee's adapting for this particular purpose, the applicable portions of Methods of Chemical Analysis of Refractory Materials (C 18) which was developed by Committee C-8 on Refractories.

Short Courses on High-Temperature Properties of Materials and Mechanics of Creep

A SHORT course on High-Temperature Properties of Materials will be held at The Pennsylvania State University from June 21 to June 25, followed by a course on Mechanics of Creep from June 28 to July 2, 1954.

Authorities from industrial, governmental, and educational institutions will give the lectures for both these courses. The programs are planned to give a broad coverage of high-temperature properties of materials and mechanics of creep by including physical, metallurgical, and design aspects of these subjects. For further information, write Dr. Joseph Marin, Department of Engineering Mechanics, The Pennsylvania State University, State College, Pa.

NEW ASTM PUBLICATIONS

Petroleum Chemistry—Marburg Lecture

RECENTLY published is the 1953 Edgar Marburg Lecture. The latest in the Marburg series, this past year's lecture is titled "An Excursion Into Petroleum Chemistry," and its author is Frederick D. Rossini, of Carnegie Institute of Technology.

Dr. Rossini who has given the latest of the series is well known in thermodynamic circles. He is head of the Department of Chemistry and is Silliman Professor at Carnegie Institute; and is also Director of the Petroleum Research Laboratory of the American Petroleum Institute. For years he was Chief of the Section on Thermochemistry and Hydrocarbons at the National Bureau of Standards. Dr. Rossini is active in ASTM's Committee D-2. He has been elected to the National Academy of Sciences; he is Chairman of the Commission on Thermochemistry of the International Union of Pure and Applied Chemistry. Author or co-author of several books and many scientific papers, he is also well known as a teacher and lecturer.

In his "An Excursion Into Petroleum Chemistry" Dr. Rossini traces highlights in the development of petroleum and petroleum products, beginning with early days in Venango County, Pa.

In the lecture he discusses the extensive projects of recent years which have been directed toward the accumulation of precise data on the physical and chemical properties of thousands of petroleum products. His lecture is literally crammed with plotted curves, tables of properties, data, diagrams, and photographs. He discusses the efforts of the American Petroleum Institute in Research Project No. 44 at some length.

The Edgar Marburg Lecture Series was originally established as a means of emphasizing knowledge of materials and to have described at Annual Meetings of the Society the development in the promotion of knowledge of engineering materials by leaders in their respective fields.

The Lecture honors and perpetuates the memory of Edgar Marburg, the Society's first Secretary.

This year's Marburg Lecture has 31 pages, 15 references.

• • •

1953 Proceedings on the Way

Proceedings of the 56th Annual Meeting of the Society are scheduled to appear by the end of March.

Containing the complete record of the meeting, committee reports, Marburg and Gillett Lectures, technical papers (other than symposiums, which appear as *STP's*), the *Proceedings* are mailed free of charge to all members and may be purchased from Headquarters by nonmembers.

Supplements to the 1952 Book of ASTM Standards

SUPPLEMENTS to the triennial Book of ASTM Standards, published in the two intervening years, keep the big Book up to date by putting into print new standards issued by the Society subsequent to the printing of the Book of Standards. 1953 Supplements which have been completed and are now in members' hands are:

Part 2. Non-Ferrous Metals—49 standards.

Part 4. Paint, Wood, Naval Stores, Wood, Sandwich Constructions, Building Constructions, Fire Tests, Wax Polishes—30 standards.

Part 7. Textiles, Soap, Water, Paper, Adhesives, Shipping Containers—46 standards.

Also completed and in the mails are:

Part 1. Ferrous Metals—61 standards.

Part 5. Fuels, Petroleum, Aromatic Hydrocarbons, Engine Antifreezes—46 standards.

Soon to come are:

Part 6. Rubber, Plastics, Electric Insulation—28 standards.

Part 3. Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing, Soils—51 standards.

Papers Committee Seeks Comment on Change in Standards Publication Size

THE Committee on Papers and Publications has been asked by one of the technical committees to look into the desirability of changing the size of the Society's publications from 6 by 9 in. to the larger 8½ by 11-in. size, having in mind particularly the standards. One of the thoughts back of the proposal would be to provide an opportunity for using somewhat larger size type, especially for the standards. Another would be that there is some feeling that 8½ by 11 in. is a more widely accepted standard size although the 6 by 9-in. size is the recognized standard under the ASA for standards published in book form.

Any change in the page size would need to be very seriously considered in view of the considerable amount of type that is now standing and which would need to be reset if the Book of Standards, for example, were to appear in the 8½ by 11-in. size. It is for this reason that the Committee on Papers and Publications is soliciting comments and recommendations with respect to the proposed change in size. There are several alternatives:

1. Change over completely with practically all of our publications (committee reports, standards, and technical papers) which would involve both *Proceedings* and the Book of Standards as well as the papers published in special technical publications.

2. To provide reprints of standards in 8½ by 11-in. size on the assumption that it is primarily the availability of standards in separate form in this larger size that is desired.

3. There is the further possibility of stepping up the present small type from 6 to 7 point type for footnotes and a number of tables but retaining the present 6 by 9-in. size. This would improve the legibility of our standards.

Comments are solicited from our members, particularly as to whether they would have use for separate standards in the 8½ by 11-in. size.

Technical Papers Published

IT IS planned to include in each issue of the ASTM BULLETIN a list of the technical papers which have recently appeared.

These lists largely comprise papers contained in the newer Special Technical Publications although some of them are advance printing of individual papers that are to appear in the *Proceedings*.

Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials

Introduction—D. G. Bennett
Some Examples of the Functional Use of Porcelain Enamel and Ceramic Coatings for Steel—G. H. Spencer-Strong
Resistance of Porcelain Enamels to Weathering—D. G. Moore
The Chemical Resistance of Glass Fused to Steel—E. A. Sanford and O. J. Britton
Acid Resisting Properties of Porcelain Enamels—H. C. Wilson
Requirements for and Expected Benefits from the Application of Coatings to High-Temperature Components of a Jet Engine—A. C. Francisco and G. M. Ault
High-Temperature Ceramic Coatings as Applied to Aircraft Power Plants—B. L. Paris
The Industrial Processing of High Temperature Ceramic Coatings—J. H. Terry
The Abrasion Resistance of Various Types of Porcelain Enamels—A. V. Sharon
The Resistance of Porcelain Enamels to Surface Abrasion as Determined by the PEI Test—J. T. Roberts
Torsion Testing as an Aid to the Porcelain Enamel Industry—E. L. Hoover
The Strengthening Effect of Porcelain Enamel on Sheet Iron as Indicated by Bending Tests—E. E. Bryant
Tension Tests of Porcelain Enameled Steel—W. A. Deringer
Effect of Temperature on the Electrical Resistivity of Several Ceramic and Silicone-Type Coatings—S. W. Strauss, L. E. Richards, and D. G. Moore
A Laboratory Evaluation of Ceramic Coatings for High-Temperature Applications—S. J. Ketcham
Guideposts in Selecting Porcelain Enamels and Ceramic Coatings—A Summary—W. N. Harrison

Symposium on Techniques for Electron Metallography

Introduction—C. M. Schwartz
Techniques Used in Electron Microscopy of Aluminum Alloys—M. S. Hunter and F. Keller
Techniques for the Study of Precipitated Carbides—W. D. Forgeng and J. L. Lamont
Inorganic Replication: Interpretation of Electron Micrographs—C. J. Calbick
Electron Microstructure of Steel by "Extraction Replica" Technique—R. M. Fisher
Metal-Shadowing for Constant Enhancement—Comparison of Shadow Metal and Shadow Angle—D. M. Teague
Specimen Polishing Techniques for Electron Metallography of Steel—W. L. Grube and S. R. Rouze
Techniques Which Permit Successive Examinations of Specific Areas by Electron Microscopy—T. A. McLauchlan
Replica Washing Methods—E. F. Fullam
Application of New Etchants for Delineation of Fine Structure in Steel—A. E. Austin
Positive versus Negative Plastic Replicas—C. M. Schwartz
Techniques for Ferrous Electron Metallography (Appendix), Third Progress Report by Subcommittee XI of Committee E-4.

Then and Now

THE elements to be considered in framing engineering standards as we practice them today are not products of 1954's thinking. Over 35 years ago these same elements were recognized in our Society. As part of a discussion at a meeting of the American Engineering Standards Organization Committee in May, 1918, Edgar Marburg outlined these important elements:

"The intrinsic value of any engineering standard and the public confidence to which it is entitled is believed to depend essentially on the following factors:

"(1) The personnel of the committee primarily responsible for the preparation of the standard, which depends in turn on the principles governing its selection and appointment.

"(2) The regulations applicable to every important detail of the activities of such a committee.

"(3) The regulations governing the action of the parent body on a proposed standard recommended by a committee.

"(4) Since regulations do not enforce themselves, the measures for ensuring vigilant supervision, due publicity and discussion, periodic revision with the progress of the art, are all features of importance, on any one of which success or failure may hinge."

Chicago Host to 57th Annual Meeting

Extensive Technical Program Developing for First Windy City Meeting Since 1941

THIS year, 1954, ASTM will desert the sand and surf of Atlantic City for the Illinois prairies and that "most American city"—Chicago—scene of the Society's 57th Annual Meeting.

The hotels Sherman and Morrison will be headquarters for the hundreds of technical people who will attend the week of June 13–18. The Sherman will also house the Eleventh Exhibit of Testing and Scientific Apparatus and Laboratory Supplies, and the 9th Photographic Display and Competition.

Technical Program Big and Varied

In this, as in all other years, the scores of technical papers presented in sessions and symposiums by competent professional men and women are the blood and bones of the meeting. These papers, covering a wide range of subjects in the materials and testing fields will be heard, discussed, and subsequently published by the Society in *Proceedings* and *STP*'s where they will become a permanent part of the world's technical literature.

In addition to the symposium program, which is outlined below in as much detail as is now available, there will be other sessions of papers and discussions in fields such as fatigue testing and concrete.

The ASTM meeting is a hard-working affair in which almost all those in attendance have work to do, especially in the scores of technical committee meetings that are held in conjunction with it.

But it's not all sessions and specifications for the ASTM'er. In the middle of the week he will take time out for dinner, entertainment, and dancing in one of the air-conditioned Sherman ballrooms.

1954 Lectures

Distinguished features of ASTM meetings are the Edgar Marburg Lecture, honoring the Society's first Secretary, and the Horace W. Gillett Lecture, commemorating one of America's leading metallurgists.

The Marburg Lecturer this year will be Harold F. Dodge, Bell Telephone Laboratories, a pioneer and leader in statistics, quality control, and related fields.

Landmarks to the Chicago visitor—Wrigley Building and Tribune Tower.

Mr. Dodge, chairman of ASTM Committee E-11 on Quality Control, will speak on "Interpretation of Scientific and Engineering Data."

The Gillett Lecturer is R. L. Templin, Director of Research and Chief Engineer of Tests, Aluminum Company of America. A Past-President of ASTM and widely known for his work in light metals, Mr. Templin will lecture on "Fatigue Properties of Aluminum."

Apparatus Exhibit

Once again the biennial ASTM Exhibit of Testing and Scientific Apparatus and Laboratory Supplies will be an important and attractive part of the Annual Meeting program. The Exhibit serves an important scientific purpose in providing a means by which our members may see at first hand many of the items of interest to them in their work. A large part of the Exhibit space has been reserved at the time this is written and, in addition to many of the old timers with whom the Annual Meeting visitors will be acquainted, a number of newcomers are expected. All will have the latest of testing apparatus, supplies, and equipment on display. The Exhibit will be close to all activities in the Sherman with booths in the Exhibit hall and on the mezzanine adjacent to the registration area.

Photographic Exhibit

The always-popular Photographic Exhibit is expected to be bigger and better than ever. The committee under the chairmanship of J. G. Heiland is working actively. Entry forms were mailed in mid-January, many weeks earlier than usual, to provide a longer period to prepare entries and to encourage more members to participate than in previous years. Special efforts are being made to encourage student participation in the Photomicrographic Exhibit.

Of extraordinary interest will be three special displays. Professor Antonio Scortecci, Istituto Siderurgico, Genoa, Italy, will exhibit a special display of color photomicrographs. B. W. Mott, Atomic Energy Research Establishment, Harwell, England, will have on display a group of photomicrographs taken with polarized light and opaque stops. Also, there will be on display the Traveling Print Show from the 1953 Photographic Society of America technical exhibit.

Effect of Cyclic Heating and Stressing of Metals at Elevated Temperatures

Sponsoring Committee: **Joint Committee on Effect of Temperature**

What We Need to Know About Creep by John S. Dorn, University of California

The Creep-Rupture Properties of Aircraft Sheet Subjected to Intermittent Load and Temperature by Glen J. Guarnieri, Cornell Aeronautical Laboratory, Inc.

The Effect of Cyclic Temperature on the Scaling Behavior of Heat-Resisting Alloys, by H. E. Eiselstein, International Nickel Co.

The Effect of Temperature Cycling on the Rupture Strength of Some High Temperature Alloys by J. Miller, General Electric Co.

Effect of Cyclic Temperature and Stress on the Stress-Rupture Strength of Type 347 Stainless Steel by E. E. Baldwin, General Electric Co.

The Problem of Thermal Stress Fatigue in Austenitic Stainless Steels at Elevated Temperatures by L. F. Coffin, Jr., General Electric Co.

Experiments on the Effects of Temperature and Load Changes on Creep-Rupture of Steels by G. V. Smith, U. S. Steel Corp.

Cyclic Creep and Stress-Rupture Behavior

of Inconel at 1700 and 1800 F by W. B. Hoyt, M. W. Kellogg Co.

Constant and Cyclic Stress Creep Tests of Several Sheet Materials by Ward F. Simmons and H. C. Cross, Battelle Memorial Institute

Improved Construction and Performance Through Building Research and Testing

Sponsoring Committee: **E-6 on Methods of Testing Building Constructions**

Definite titles are not yet available.

R. H. Gloss, Timber Engineering Co. A summary of tests on full scale timber, arches, trusses, and isolated joints under simulated loadings.

A. J. Steiner, Underwriters' Laboratories. Fire tests of building structures and building materials and their utilization in building code requirements.

J. R. Stillinger, Oregon Forest Products Laboratory. A summary of correlative work between laboratory and full-scale tests of timber construction.

Engineer Research & Development Laboratories, Corps of Engineers, U. S. Army. Structural and environmental evaluation of pre-fabricated buildings.

C. B. Monk, Jr., Armour Research Foundation. Correlation Between Laboratory and Field Tests of Brick Walls.

R. F. Luxford, U. S. Forest Products Laboratory. Glued and nailed roof trusses for light frame construction.

L. W. Wood, U. S. Forest Products Laboratory. Structural performance requirements in housing codes.

Odor

Sponsoring Committee: **D-22 on Methods of Atmospheric Sampling and Analysis**

Accurate Measurement of the Intensity of Odors by Louis C. Barail, Consulting Biochemist and Toxicologist

Odor Pollution from an Official's Viewpoint by Charles W. Gruber, Cincinnati Bureau of Smoke Inspection

Measuring Concentrations of Hydrocarbon and Organic Vapors in Air by Catalytic Combustion by R. J. Ruffe, Catalytic Combustion Corp.

Odor: A Proposal for Some Basic Definitions by Edward Sagarin, Standard Aromatics, Inc.

Studies of Submarine Atmospheres by Julius Sendroy, Naval Medical Research Institute

A Method for Measuring the Emission of Organic Odors from Industrial Stacks, Automotive Exhausts, and Other High Concentration Sources by W. R. Calvert, Oxy-Catalyst

Organoleptic Appraisal of Three Component Mixtures by A. H. Gee, Foster D. Snell, Inc.

Odor Control Methods: A Critical Review by A. Turk, Connor Engineering Corp.

It may not mean much now—BUT—

in June you might be glad to know that all the meeting rooms, exhibit areas, and dining rooms at the Hotels Sherman and Morrison are AIR CONDITIONED.

Permeability of Soils

Sponsoring Committee: **D-18 on Soils for Engineering Purposes**

Controlled Test Methods in Permeability Testing and Interpretation of Test Data by Donald M. Burmister, Columbia Univ.

The Effect of Gravel Content on the Permeability of Laboratory Sand-Gravel Specimens by C. W. Jones, Bur. Reclamation.

Water Movement Through Porous Hydrophilic Systems Under Capillary, Electric, and Thermal Potentials by Hans F. Winterkorn, Princeton University

Measurement of the Hydraulic Conductivity of Soil in Place by Don Kirkham, Iowa State College

Permeability Measurements on Compacted Soil by T. W. Lambe, Massachusetts Institute of Technology

Low-Head Permeameter for Granular Materials by E. G. Yemington, Bureau of Public Roads.

Sampling and Testing of Ground Water Samples by W. O. Smith, Geological Survey.

Fluid Permeation Terminology by J. E. Jacob, Brigham Young Univ.

Permeability Test for Fine Sands by T. Y. Chu and D. T. Davidson, Iowa State College.

Temperature Classification of Insulating Material

Sponsoring Committee: **D-9 on Electrical Insulating Materials**

Improved Specimen Holder for Use at Temperatures Up to 500 C by A. H. Scott, P. Ehrlich, J. F. Richardson, National Bureau of Standards

Dielectric Measurements at High Temperatures by Carl Brodhun, E. I. du Pont de Nemours & Co., Inc.

Some Properties of Thermosetting Material at Elevated Temperatures by R. R. Winans, New York Naval Shipyard

Dielectric Properties of Certain Plastics at Temperatures up to 200, and Some Problems Encountered in Measuring Them by Thomas Hazen, Bakelite Corp.

Stability of Plastics by R. R. Winans, New York Naval Shipyard

Thermal Stability of Polyvinyl Chloride Insulating Compounds by R. C. Bartlett, Natvar Corp.

Aging of Silicone Treated Glass Cloth by O. E. Anderson, Westinghouse Electric Corp.

Thermal Stability of Varnished Cloth and Tapes Used for Electrical Insulation by R. C. Bartlett, Natvar Corp.

Heat Aging of Insulating Varnish by H. I. Morgan and K. N. Mathes, General Electric Co.

High Temperature Characteristics and Stability of Insulating Varnish by A. H. Haroldson, Continental-Diamond Fibre

Heat Stability of Silicones by J. S. Hurley, General Electric Co.

Heat Stability of Mica Products by K. Coutlee, Bell Telephone Labs.

High Temperature Properties of Mica by J. Ruscito, Scintilla Magneto

Test Method Modifications for High Temperature Fluorocarbon Plastics by M. A. Rudner, U. S. Gasket Co.

Heat Aging of Sheet and Tape Insulation by K. N. Mathes and H. I. Morgan, General Electric Co.

Coal Sampling

Sponsoring Committee: **D-5 on Coal and Coke**

The Development of the Theoretical Basis of Coal Sampling by W. M. Bertholf, Colorado Fuel & Iron Corp.

A Test Accuracy of a Revolving Spoon Sampler by A. O. Blatter, Union Electric Co. of Missouri

Tests of Accuracy of a Mechanical Coal Sampler by R. L. Coryell and F. J. Schwerd, Consolidated Edison Co.

Multi-Lot Sampling, the Accuracies in Sampling of Large Coal Shipments by T. A. Miskimen and R. S. Thurston, American Gas & Electric Service Corp.

Tests of the Geary-Jennings Sampler at Cabin Creek by W. M. Bertholf, Colorado Fuel & Iron Corp., and W. L. Webb, American Gas & Electric Corp.

Recent British Work on Coal Sampling by R. W. Tomlinson, National Coal Board

The Variance of Reduction and Analysis by W. W. Anderson, Commercial Testing and Engineering Co.

Few sightseers miss this famous Chicago building, the Elks War Memorial

ASTM Bulletin

FEBRUARY, 1954

NO. 196

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

1953 Financial Report Shows Favorable Operations

Investment Plan Gets Under Way

THE report on 1953 financial operations of the Society, given by the Executive Secretary at the January 19 meeting of the Board of Directors, indicated a very favorable year with a substantial balance resulting. Full consideration was given to the Society's finances at the December meeting of the Finance Committee preceding the January Board meetings. The complete auditors' report was available at the latter and information from this and from the Executive Secretary's report is given below.

It has been the policy of the Directors to provide the members with full information on our financial operations, investment portfolio, and other related subjects. As usual, details will be given in the printed report of the Directors to the Society which will be made at the 57th Annual Meeting in Chicago in June.

Reference was made in the January BULLETIN to the appointment of an Investment Advisory Committee reporting directly to the Finance Committee. In this committee periodic reviews of our investment portfolio are to be made and gradually there will be put into effect a formula plan for investing.

Operating Receipts in 1953

The operating receipts for 1953, totaling $814,640, establish a new record high. The accompanying table shows the major sources of receipts and comparable data for the three preceding years. While receipts from dues increased during the year as a result of membership growth, the table below will show that there was not the pronounced increase, for example, that was shown between 1951 and 1952. Nevertheless, the steady growth is encouraging and reflects widening interest in the work of the Society. Total income from dues, entrance fees, etc., was $233,705.

Perhaps the most notable point in connection with operating receipts is that dues for the first time fell below 30 per cent of our total income, and, conversely, sales of publications represented 62.9 per cent of income. In the 1920's and 1930's dues represented from 49 to 70 per cent of the Society's annual receipts. Beginning in the 1940's, however, this percentage gradually decreased, ranging around 35 per cent.

The chief reason for the very large income from publications for 1953 was, of course, the appearance of the new Book of Standards, the sales receipts from which came in during this year. However, income from sales of other publications was high, special compilations of standards, for example, totaling almost $80,000, and there was almost $93,000 income from special and miscellaneous books. The total was $512,262, which includes the charge to members for additional parts of the Book of Standards. In reviewing these figures it should be kept in mind that the Society's financial operations should be considered over a three-year period taking into account the triennial publication Book of Standards.

The income from miscellaneous sources is influenced by the receipts from the Society's apparatus exhibit which is held biennially and since no exhibit was held in 1953 the figure for miscellaneous income is somewhat lower than in 1952.

Income from interest and dividends was up about $2700, reaching almost $22,000. Reference is made later in a discussion of investments of the Finance Committee's desire to increase this source of income.

Operating Disbursements in 1953

With the Society's work continually expanding and publication and other costs increasing considerably, it is not surprising that the operating disbursements for 1953 are considerably higher than they have been previously, totaling this year, $721,123. Reference to the accompanying table will indicate that publication costs, exclusive of overhead, labor, etc., total almost $323,800. The tabular data do not include a fund of $60,000 set aside and not expended to aid in defraying costs of the 1955 Book of Standards.

Disbursements for salaries total 33 per cent of the monies expended in 1953. This compares with an average ratio of the five preceding years of just under 35 per cent.

The Society's contribution to the retirement Plan for ASTM Employees was $17,440, about 2.4 per cent of total disbursements, and about 7.3 per cent of the salary roll.

Headquarters Building Expansion

Late in the year the Society procured a combined office building and garage and other property directly at the rear of the present Headquarters Building. This property adjoins the lot which ASTM had purchased earlier. In this transaction three-quarters of the lot was sold to the Academy of Natural Sciences, one of our neighbors, and the proceeds were used to cancel a note which had been carried on the lot and the current building.

At a total cost of about $87,000 the Society procured the building with lot frontage of about 90 ft and depth of about 129 ft. The whole area in which the Society's headquarters are located is in process of redevelopment and expansion because of the changes incident to the removal of the Pennsylvania Railroad tracks and the Broad Street Station. The new property was paid for from the Society's current funds and the repairs and rehabilitation will be handled in this same manner.

Summary of 1953 Operations

Comparison of operating receipts with disbursements shows a favorable operating balance of about $78,717. Normally in the first year following the appearance of the Book of Standards a good balance is hoped for to help underwrite any deficits which may occur in the following two years, and as noted later a deficit is budgeted for 1954.

Assets and Net Surplus

The balance sheet of the Society on December 11, 1953, showed assets in the General Funds of $612,858; liabilities,

OPERATING RECEIPTS.

Source	1953		1952		1951		1950	
		Per cent		Per cent		Per cent		Per cent
Dues	$233 705	28.7	$226 284	34.9	$215 024	35.1	$205 581	34.6
Sales of Publications	512 262	62.9	338 448	52.2	340 605	55.5	325 998	54.8
Miscellaneous								
Advertising	28 398	...	30 607	...	30 783	...	32 003	...
Interest and Dividends	21 956	...	19 264	...	14 365	...	9 896	...
Registration Fees	13 768	...	14 277	...	7 425	...	7 327	...
Exhibit	1 355	...	16 243	...	1 622	...	8 913	...
Other	3 196	...	3 320	...	3 483	...	4 356	...
Total Miscellaneous	68 673	8.4	83 621	12.9	57 678	9.4	62 495	10.6
TOTAL RECEIPTS	$814 640	100.0	$648 352	100.0	$613 307	100.0	$594 074	100.0

OPERATING DISBURSEMENTS.

Item	1953		1952		1951		1950	
		Per cent		Per cent		Per cent		Per cent
Publications	$263 811*	44.9	$259 823	41.9	$246 291	42.3	$231 825	44.2
Salaries	237 761	33.0	211 817	34.2	206 959	35.5	184 250	35.2
General Office Expense	75 773	10.5	60 475	9.7	59 868	10.2	42 191	8.1
Meetings and Technical and District Committees	23 253	3.2	31 335	5.0	22 436	3.8	22 311	4.3
Headquarters Occupancy	21 658	3.0	24 001	3.9	18 618	3.2	17 535	3.4
Retirement, Health	21 070	2.9	16 013	2.6	17 289	2.9	14 851	2.8
Miscellaneous	17 797	2.5	16 566	2.7	12 738	2.1	10 243	2.0
TOTAL DISBURSEMENTS	$661 123*	100.0	$620 030	100.0	$584 199	100.0	$523 206	100.0

* Does not include $60,000 earmarked as a reserve for the 1955 Book of Standards, and not expended.

including accounts payable and all reserve funds, total $264,254, leaving a net surplus of $348,604, which is about 52.7 per cent of the current operating disbursements—in other words, enough to run the Society for just six months.

In addition to the General Funds, the balance sheet also shows assets in the Building Fund of $322,045. In Special and Designated Funds, including Committee Funds, are assets of $260,500. The total consolidated assets of the Society on December 11, were $1,195,403.52.

Investments

The book value of the Society's investments in all funds (that is, General, Building, Research, Committee, and Medal and Lecture Funds) was $448,814 on December 11, 1953. Market value was $461,679. During the year the Finance Committee has devoted much thought to investments. It has been of concern that during an inflationary period the portfolio did not appreciate proportionately with inflation and certainly not to the extent that the committee hoped for. Steps are being taken to scrutinize the portfolio more closely, an Investment Advisory Committee has been appointed, and a formula plan for investing is to be set up as soon as feasible. This will be based on the policy of having always available at least three months' average operating disbursements in cash, and that at no time should cash, bonds, and fixed assets be less than 40 per cent of our total cash and investments. The percentage of equities or common stocks will vary from time to time depending upon market conditions. There has been a feeling, too, that more of the Society's funds could be invested. Certainly it is desirable with our expanding technical publications and operations to have increasing income from investments. As of December the percentage of equities in our *investments* was about 59 per cent but if cash is included and certain balanced mutual funds are omitted, the equity figure drops to below 35 per cent.

1954 Budget

The 1954 budget approved by the Directors, estimates current income at $720,500, disbursements at $761,500, leaving a deficit of about $41,000.

As noted above, it is not unusual in the second and third years following publication of the Book of Standards to have the budget operations show a deficit. While this has not developed in recent years, still the Finance Committee feels that the income should be estimated conservatively and our expenses liberally. The following table provides a summary of the budget:

BUDGET SUMMARY.

Estimated Receipts

		Per cent
Dues and Entrance Fees	$232 500	32.3
Publications	407 500	56.5
Miscellaneous	80 500	11.2
TOTAL CURRENT RECEIPTS	$720 500	
From Surplus	$41 000	
	$761 500	

Estimated Disbursements

Publications	$285 500	37.5
Salaries	275 000	36.2
General Office Expenses	81 100	10.6
Technical Committee Expenses	13 000	1.7
Meetings	20 300	2.7
Headquarters Occupancy Expenses	39 550	5.2
Retirement, Health	23 100	3.0
Miscellaneous Expenses	23 950	3.1
TOTAL OPERATING DISBURSEMENTS	$761 500	

This budget will be reviewed from time to time by the Finance Committee and changes made as developments occur. No one can foresee what may develop in 1954 and 1955, but with the increasing expansion of the Society's work, continued heavy publication schedule, and the support of a growing membership, it is hoped the financial operations will continue on an encouraging and satisfactory basis.

1954 Industrial Health Conference

METHODS of raising occupational health standards will hold the spotlight when members of the American Industrial Hygiene Assn. gather for the 1954 Industrial Health Conference, April 26 to 30, at the Hotel Sherman in Chicago.

The five-day meeting includes seminars, speeches, demonstrations, and panel discussions which will cover more than ninety topics of prime interest to industrial management and medical personnel.

The theme of the conference will be "Protecting our greatest industrial wealth—employees' health." The nation's leading hygienists . . . authorities on occupational health . . . will shed new light on subjects ranging from industrial safety to air-pollution, to occupational diseases. They will discuss enlightened business management, and its new alertness to the importance of industrial hygiene, with its broader concept of employee health.

Commercial and scientific exhibits will further point up methods of improving industrial health and reducing its hazards.

Award Established in Honor of Frank E. Richart

THE Directors are pleased to announce the establishment of the Frank E. Richart Award which has been made possible through the interest of his family.

An honorary member of the Society, a long-time worker and officer, and chairman of Committee C-9 on Concrete and Concrete Aggregates in which field he was an outstanding authority, Professor Richart was Senior Vice President of ASTM when he became ill. He died in July, 1951, shortly after attending the Annual Meeting in Atlantic City.

Considering the nature of his work, it is natural that the award should be given for outstanding technical investigations in the field covered by Committee C-9. The award, consisting of a suitably engrossed certificate and an honorarium, the amount of which will be decided by the Board of Directors, is to be given not oftener than every three years. The committee that will make the selection for the first award includes H. J. Gilkey, chairman, L. W. Teller and K. B. Woods.

Frank E. Richart

Professor Richart devoted a great amount of energy and time to the work of the Society both in its technical and administrative phases and was held in extremely high regard by all his friends and associates in ASTM. It is fitting therefore, that the Directors should accept this award which does honor to the Society in perpetuating Professor Richart's name.

Summary of Rules Governing the Frank E. Richart Award

(*Copies of the complete rules are available on request and will be included in a new* Manual on Society Lectures and Awards, *now being printed.*)

The Frank E. Richart Award was established in 1953 by a gift from Mrs. Richart to honor and perpetuate the memory of her husband.

The Award will recognize outstanding work in ASTM by members and committee members of the Society in the fields covered by Committee C-9. This includes the development and analysis of data on the properties of concrete and concrete aggregates, the development of test methods or specifications, and the preparation and presentation of technical papers and reports, which present new and useful information, describe new testing procedures and apparatus, or otherwise contribute to the advancement of our knowledge in these fields.

The Award consisting of a suitable certificate and cash shall be given periodically, but not more often than every third year.

A Committee to recommend the recipient or recipients shall be appointed periodically by the Board of Directors and shall consist of not less than three nor more than five members of the Society, who shall be eligible for reappointment. (It is intended that the Award Committee will serve continuously until an award is made, at which time the Board of Directors will appoint a new committee.)

The Award Committee may develop various means for ascertaining outstanding contributions to research, standardization, or the development and presentation of technical papers in the field.

Technical papers which may be considered by the Committee shall have been accepted for publication in their entirety by the Society. Customary ASTM rules concerning papers eligible for awards shall govern consideration of the respective papers. They shall be the bona fide production of those who contribute them and shall have been accepted by the Administrative Committee on Papers and Publications. They may be presented at ASTM national, district, or special meetings, or printed in Society publications.

Except in the first two years after an award is made, the Committee shall re-

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

Date	Group	Place
Feb. 23	Southern California District—Joint Meeting with AIChE	Los Angeles, Calif.
Feb. 25	Northern California District	San Francisco, Calif.
March 2	Washington-Oregon Area — Joint Meeting with AIChE and ASM	Richland, Wash.
March 4	Washington-Oregon Area Meeting	Tacoma, Wash.
March 4	Committee E-2 on Emission Spectroscopy	Pittsburgh, Pa.
March 5–6	Committee E-13 on Absorption Spectroscopy	Pittsburgh, Pa. (William Penn Hotel)
March 17	Philadelphia District—Joint Meeting with ACS	Wilmington, Del.
March 17–19	Committee D-13 on Textile Materials	New York, N. Y.
March 17–19	Committee D-15 on Engine Antifreezes	Washington, D. C.
March 22–23	Committee D-12 on Soaps and Other Detergents	New York, N. Y.
March 22–24	Committee D-20 on Plastics	Roanoke, Va.
March 24–26	Committee D-9 on Electrical Insulating Materials	Roanoke, Va.
March 31	Detroit District	Detroit, Mich.
April 7–9	Committee D-14 on Adhesives	Pittsburgh, Pa. (Mellon Institute)
April 8–9	Committee D-10 on Shipping Containers	Atlantic City, N. J. (Claridge Hotel)
April 13	New York District—Joint Meeting with TAPPI	New York, N. Y. (Fraunces Tavern)
April 22	New England District Meeting	Storrs, Conn.
May 25, 27, 28	Committee E-14 on Mass Spectrometry	New Orleans, La. (Hotel Jung)
June 13–18	**ASTM Annual Meeting (Eleventh Exhibit of Testing and Scientific Apparatus and Laboratory Supplies and Ninth Technical Photographic Exhibit)**	**Chicago, Ill. (Sherman and Morrison Hotels)**

port to the Board of Directors annually, not later than April 1, whether or not an award is recommended. A recommendation shall include an appropriate statement on the basis for selection of the recipient or recipients, and a recommendation on amount of the cash award.

The Board of Directors shall have final authority in the management of the funds involved, the amount to be paid, shall decide any question not specifically covered in these rules, and make such modifications thereof as may seem desirable.

Conference on Defects in Crystalline Solids

THE H. H. Wills Physical Laboratory of the University of Bristol, in cooperation with the International Union of Pure and Applied Physics and with The Institute of Physics, is organizing a conference on "Defects in Crystalline Solids" to be held July 13–17, 1954, in Bristol. While not excluding other subjects in the field, the organizers propose to give particular attention to defects such as dissolved atoms, vacancies and F-centers, to microwave resonance methods of investigating their properties, and to the way in which they react with dislocations.

Further particulars may be obtained from the Secretary, H. H. Wills Physical Laboratory, Royal Fort, Bristol 8, or from the Secretary, The Institute of Physics, 47, Belgrave Square, London S.W. 1.

YOUR APRIL ISSUE—

of the ASTM BULLETIN will carry the technical summaries of the Washington meetings of 43 ASTM technical committees.

Administrative Committee on Research Continues Active Program

More Than 500 Requests for "Review of ASTM Research"

ALTHOUGH ASTM is internationally recognized for its standardization work the research activities of the Society have received somewhat less attention. The Administrative Committee on Research plans to continue its efforts to publicize this fundamental and important phase of the Society's work.

The "Review of ASTM Research" which outlined the research activities of the various technical committees was prepared by the ACR and published in several issues of the ASTM BULLETIN. It was made available in May, 1953, as a separate reprint and was subsequently distributed to a number of technical journals. Mention of the availability of this review has already resulted in more than 500 requests for copies many of which came from foreign countries including England, Canada, Netherlands, New Zealand, Iceland, India, and Spain.

"Some Unsolved Problems," which appeared serially during 1952 and 1953 in the ASTM BULLETIN, were collected and published in a separate 20-page pamphlet. This reprint was distributed to some 2000 deans and department heads of accredited colleges and universities in this country and Canada. Three hundred sixty-eight replies were received commending the ACR for its efforts and many contained offers of assistance and suggestions for new work.

A second mailing of "Some Unsolved Problems" made to almost 1000 directors and heads of commercial and industrial laboratories in this country resulted in a similar favorable response (16.3 per cent) from this group.

Details of these replies and their relation to the work of the technical committees will be published in future issues of the BULLETIN. The last of the current series of unsolved problems appears on page 19. In the near future the pamphlet "Some Unsolved Problems" will again be brought to the attention of the technical committees indicating that additional problems will be welcome.

Research Column in BULLETIN

A REGULAR column "ARC Notes" is planned for the BULLETIN, starting with the April issue, to include information regarding ACR activities and particularly pertinent comments in response to the distribution of "Some Unsolved Problems."

The ACR plans to assemble and maintain an up-to-date list of available speakers with the thought that they would be of assistance to ASTM Districts. It is intended that the speakers will be men particularly capable of discussing various phases of research currently in progress within the technical committees or which may have a bearing on future work of the committees. Suggestions for speakers of this type will be appreciated and should be sent to the Administrative Committee on Research, ASTM Headquarters, 1916 Race St., Philadelphia, 3, Pa.

To ASTM Nonmembers: The Society welcomes inquiries on the "Advantages of Membership"

To the ASTM Committee on Membership,
1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on Membership in ASTM and include a membership application blank.

Signed_____

Address_____

Date_____

A. G. Ashcroft to Receive H. De Witt Smith Medal

THE fifth award of the H. De Witt Smith Memorial Medal will be made by ASTM Committee D-13 on Textile Materials to A. G. Ashcroft Vice-President and Director of Research & Development, Alexander Smith, Inc.

The medal will be presented to Mr. Ashcroft at a luncheon in his honor on March 18 during the spring meeting of Committee D-13, March 17 to 19, at the Statler Hotel, New York City. Mr. Ashcroft is recognized as a leader in the work of Committee D-13, and has served as chairman of the subcommittees on wool and its products, pile fabrics, and sampling, presentation, and interpretation of data. In 1949, the wool subcommittee presented him with a scroll in recognition of his service as its chairman for 10 years. He also served on the Board of Directors of the Society. He is a member of the board of trustees of the Textile Research Inst. and a former president of the Research Institute.

The medal, a testimonial to the memory of the late Harold De Witt Smith, was endowed by Fabric Research Laboratories, Inc., Boston. It is awarded at intervals of not less than one year by Committee D-13 for outstanding achievement in the field of fiber science and utilization, which includes the development and promotion of knowledge of textile fibers and structures, and methods for the evaluation of their properties.

Other recipients of the Award have been Herbert F. Schiefer, Edward R. Schwarz, Frederic Bonnet, and Herbert J. Ball.

Toward Better Presentation of Technical Papers

Papers Committee Tries Voluntary Plan to Improve Listener Interest

IT IS expected that any scientist, by ability or training or both, should be able to communicate his thoughts to his fellows through effective presentation of the spoken word, as well as the written. Already many of our scientists and engineers have realized the value of employing a little salesmanship, showmanship, histrionics—call it what you will—in order to explain successfully what they have been doing. They have found that, in these times of inevitable technical specialties bred by expanding science and engineering, an audience made up of even their own associates is often not entirely familiar with the particular specialties being described by the speaker. Time spent in improving their ability to convey an idea or concept, they find, is a good technical investment.

Here in ASTM, our own Papers Committee is selfishly interested in this matter from the point of view of improving the interest of the technical sessions by improving the character of presentations of technical papers. First of all they wish to try out a plan for appraising the presentations. The problem of equitably judging the many presentations to be made in so many sessions is admittedly quite formidable. Obviously the members of the Papers Committee, with their other individual commitments, cannot hear all papers—particularly when there may be many simultaneous sessions. The assembly, training, and assignment of an adequate panel of judges also seemed too laborious and unwieldy to be workable. A way out of this impasse was to supplement the Papers Committee with reporters, rather than judges, each of the latter being asked to fill out a standard report card on the presentations which he hears. The committee has worked up a standard sheet of items usually associated with effective presentation and they plan to use this in gathering data for further study. The check list will be sent in advance to authors who plan to present papers at the meeting.

Confidential Report Card

The accompanying report card lists systematically a number of characteristics of speakers and paper presentations. With check marks and one-word replies a reporter can give a comprehensive, objective statement of what a speaker does. He does not have to compare speakers nor assess how good or how poor are their efforts. He may offer such opinions if he wishes, but the standard report is all that is required.

The reporters for each session will be chosen by its chairman. Just before he opens the session, the chairman will select three persons in the audience, supply each with a packet of report cards, and ask them to serve as reporters. At the end of each session the reporters will give their sets of report cards to the session secretary, to be held for appraisal by the Papers Committee.

No awards and no criticisms are planned. Any author may write to

---

To ASTM Members: Your help is needed in maintaining that constant increase in ASTM Membership

---

To the ASTM Committee on Membership,
1916 Race St., Philadelphia, 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below:

_____

_____

This company or individual is interested in the following subjects: indicate field of activity, that is, petroleum, steels, non-ferrous, etc.

_____

Signed _____

Date _____ **Address** _____

the chairman of the Papers Committee after the Annual Meeting and obtain his check sheet if he is interested.

Comment Welcomed

It is hoped that refinements and improvements in the original system can be made. The comments and suggestions of sessions officers and reporters are being solicited directly in the course of reporting. Ideas of others, either authors or hearers, will be welcome and should be sent to the Papers Committee at Headquarters. Volunteer descriptive comments on particularly good presentations should be especially helpful. A preliminary trial last year showed that the plan had promise and at the approaching Annual Meeting we shall have a more complete trial.

The committee hopes to find some of the answers regarding the presentation of papers in our Society and perhaps at the same time obtain livelier, more stimulating sessions at the Annual Meeting.

Paint Research at NYU

A NEW method of measuring chemical conversions which take place in pretreatments used as paint bases for steel surfaces has been devised from experiments in New York University's College of Engineering.

The new system is expected to aid production control by controlling the solubility of paint bases. An organic coating applied over the base will become more durable if the chemical pretreatment base can be made as insoluble as possible.

The experiments pointed to a convenient and practical control method in the pretreating of steel surfaces with metal-phosphate coatings.

The new method consists of measuring—through loss of electrical resistance—the transfer of water-soluble matter from the pretreated surface. The NYU research workers immersed treated steel panels in distilled water whose resistance they previously measured. The research team then took measurements as frequently as possible during test periods up to 2 min, since most of the unconverted chemicals quickly dissolve in water.

In the next step, organic coatings were applied to chemically pretreated bases of various solubilities. The research group found that under salt-fog exposure, the life of coatings was closely related to the success of the pretreatment conversion before paint application.

Report of Technical Paper Presentation

Date:_____ Session No.:_____ Program No:_____
Speaker:_____ on (Subj.)_____

Timing
Speaker started_____ m; stopped_____ m; elapsed time_____ m.
Spoke too long_____; not long enough_____.
Did he finish_____.

Organization
Gives a recognizable introduction_____.
Includes outline of talk in introduction_____.
Are topics discussed in logical order_____.
Is their interrelationship made clear_____.
Are they summarized at the end_____.
Does speaker close with a punch line____, or just runs down____.

Manner
Reads manuscript_____; talks from manuscript or notes;_____ talks without notes_____.
When looks at audience: All the time_____, part of time_____, never_____.
How looks at audience: Over heads_____, one person or area _____, separate persons_____.
Movement: Stands rigid_____, stands or moves easily_____, moves excessively_____.
Gestures: Mechanical_____, violent_____, appropriate_____, none_____.
Mannerisms: Clutches lectern_____, hands in pockets_____, other (describe):_____

Are these helpful_____, distracting_____, or absent_____.

Speech
Heard by reporter: None_____, most_____, all_____.
Enunciation: Good_____, fair_____, poor_____.
Unusual terms: None_____, some_____, many_____, were they explained_____.
Sentences: Smooth_____, jerky_____, involved_____.
Objectionable transitions: "er" or "ah" habit_____, "and" habit_____, complete sentences_____.
Voice Inflection: Loud_____, monotone_____, varied_____, emphatic_____.

Visual Aids
Type: Motion picture_____, slides_____, charts_____, specimens_____, blackboard_____, demonstrations_____.
Quantity: Too many_____, too few_____, adequate_____.
Quality: Readable by all_____, distinct image_____, superfluous detail_____.

Use by speaker:
Addresses audience ( ) or neglects audience ( ) while using.
Reads legends or tabular material from visual aid to audience: Yes_____, No_____.
Aid illustrates and explains a point in talk_____, distracts from talk_____, talk consists of comments on visual aids_____.
Too fast_____, too slowly_____.

General
Have you a clear idea of speaker's theme_____.
Was he convincing to you_____.
Did he *sell* his audience_____.
Additional comment by reporter:

Today, with our greater understanding, there is humility in the minds of all scientists. The further we penetrate into Nature's secrets, the more clearly we see the ever-receding frontiers of knowledge.

Sir Harold Hartley

The National Research Council

Closely allied to ASTM interests is the work of the National Research Council of the National Academy of Sciences, Government advisory organization—

THE National Academy of Sciences is a private nonprofit corporation dedicated to the furtherance of science for the general welfare, and is required by its Congressional charter to act as an official adviser on scientific matters to the Federal Government. Its members, numbering now about 240, are drawn from academic, industrial, and Government organizations throughout the country. All members of the National Research Council receive their appointments from the President of the National Academy of Sciences.

Organized in World War I

The National Academy of Sciences organized the Council during the first World War in response to a request from President Wilson for assistance in mobilizing the scientific resources of the country. It was appropriate that the President should turn to the National Academy for scientific assistance to the Government since the corporation charter of the Academy, passed by Congress and approved by President Lincoln in 1863, provides that "... the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any service to the Government of the United States."

Perpetuated by Wilson's Executive Order

At the close of World War I President Wilson, desiring to perpetuate the National Research Council, issued the following Executive Order:

"The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the Council in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is therefore requested to perpetuate the National Research Council the duties of which shall be as follows:

Duties Outlined

"1. In general, **to stimulate research** in the mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge of strengthening the national defense, and of contributing in other ways to the public welfare.

"2. **To survey the larger possibilities of science,** to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

"3. **To promote cooperation in research,** at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative, as fundamentally important to the advancement of science.

"4. **To serve as a means of bringing American and foreign investigators into active cooperation** with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the Government.

"5. **To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war,** and to aid in the solution of these problems by organizing specific researches.

"6. **To gather and collate scientific and technical information,** at home and abroad, in cooperation with governmental and other agencies, and to render such information available to duly accredited persons.

"Effective prosecution of the Council's work requires the cordial collaboration of the scientific and technical branches of the Government, both military and civil. To this end representatives of the Government, upon the nomination of the National Academy of Sciences, will be designated by the President as members of the Council, as heretofore, and the heads of the departments immediately concerned will continue to cooperate in every way that may be required."

The Council includes the following eight divisions:

Physical Sciences—R. C. Gibbs, chairman
Mathematics—A. Adrian Albert, chairman
Engineering and Industrial Research—Willis A. Gibbons, chairman
Chemistry and Chemical Technology—W. A. Noyes, Jr., chairman
Geology and Geography—Ernst Cloos, chairman
Medical Sciences—M. C. Winternitz, chairman
Biology and Agriculture—Paul Weiss, chairman
Anthropology and Psychology—Harry L. Shapiro, chairman

These divisions carry on their work through permanent boards and institutes, committees, subcommittees and panels, as well as *ad hoc* groups for special projects.

Endowment Support

Financial support of the administration is derived in part from a gift some years ago of five million dollars to the National Academy of Sciences from the Carnegie Corp. of New York, and from other special funds. A portion of this gift was used for erection of a building in Washington, but the greater part of the gift constitutes a permanent endowment, the income from which is used for the general purposes of the Academy-Research Council, including maintenance of the buildings. The scientific research in

which the Academy-Research Council participates directly is much more extensive than the annual budget would indicate, however. Several public and private agencies spending several million dollars annually for research depend upon the advice of the Academy-Research Council in determining the distribution of their funds.

Stimulates and Coordinates Research

The Academy-Research Council does not maintain laboratories of its own but seeks to stimulate and support the work of individual scientists and to coordinate investigations dealing with broad problems in research both nationally and internationally. This is carried out through a wide variety of means, including conferences, technical committees, surveys, collection and collation of scientific and technical data, the sponsorship of scientific publications and research organizations, and the administration of public and private funds for research projects and fellowships.

A review of the NRC is contained in the Annual Report of the National Academy of Sciences to the Congress of the United States. In addition scientific reports are published, reviews of the status of research in special fields, directories of research laboratories and personnel, abstracts, glossaries, handbooks, and other published aids to research. The bimonthly *News Report* of the Academy-Research Council contains information on current activities, news of cooperating societies and international developments in science. A list of publications may be obtained from the Publications Office on request.

ASTM Represented

The Society is particularly close to the work of the Division of Engineering and Industrial Research of the Research Council and is represented in this Division by Bruce W. Gonser. It is also represented on the NRC, Advisory Committee on Highway Research by K. B. Woods. An informal liaison is maintained with the NRC Building Research Advisory Board.

The Society is also interested in the NRC Committee on Spectral Absorption Data.

Another Unsolved Problem

Adhesion of Asphalt to Coarse Aggregate

Statement of Unsolved Problem Contributed by Committee D-4 on Road and Paving Materials

Problem:

Bituminous binders used in bituminous paving mixtures, bituminous surface treatments, and bituminous macadam are often caused to "strip" or separate from the aggregate when moisture conditions are severe. This stripping tendency causes softening of compacted paving mixtures and loss of cover stone from surface treatments. A satisfactory test has been devised and standardized for measuring quite accurately the softening effect of water on compacted mixtures containing graded aggregates (Tentative Method of Test for Effect of Water on Cohesion of Compacted Bituminous Mixtures (D 1075–49 T), 1952 Book of ASTM Standards, Part 3, p. 1301) but all attempts so far, to develop a quantitative measure of stripping on bituminous coated coarse aggregates have resulted more or less unsatisfactorily because the degree of stripping has had to be estimated by visual observation. A stripping test is needed for evaluating the hydrophilic properties of gravels and quarry materials for surface treatments and macadam independently of other aggregates such as sand and filler that might be added to make up a graded paving mixture.

Present State of Knowledge:

For several years Subcommittee B-22 and subsequently Subcommittee B-26 of Committee D-4 have worked on this problem. A report of the work done in which emphasis is placed on the inadequacies of the test methods so far devised was prepared by Subcommittee B-26 and is recorded as appendix II to the 1952 Annual Report of Committee D-4 (see Introductory References). The test method that was used in a considerable part of the work was presented with the admonition: "However this method is not proposed for standardization by ASTM since the precision is indicated to be inadequate.... A more precise, direct procedure is needed which will be independent of the personal element."

A method of evaluating stripping for aggregates after coating dry and involving the precoating of the aggregate sample with radioactive isotopes and the use of a scintillation counter for measuring stripping is being studied by one member of Subcommittee B-26. This method appears rather promising but the field is still definitely open for a simple and reasonably accurate test method.

Questions That Need to Be Answered:

The need is for a test that will evaluate stripping in terms of weighable or measurable quantities for aggregates coated wet or dry.

Introductory References:

(1) Division of Tests, Bureau of Public Roads, "Effect of Glassy Slag on the Stability and Resistance to Film Stripping of Bituminous Paving Mixtures," *Public Roads*, Vol. 22, p. 209 (1941).

(2) P. F. Critz and J. F. Goode, "Additives for Bituminous Materials," *Public Roads*, Vol. 24, p. 131 (1945); see also report by J. T. Pauls and H. M. Rex, "A Test for Determining the Effect of Water on Bituminous Mixtures" (same issue).

(3) 1952 Report of ASTM Committee D-4 on Road and Paving Materials, Appendix II, "Stripping Tests for Bitumen-Aggregate Mixtures," *Proceedings*, Am. Soc. Testing Mats., Vol. 52, p. 402 (1952).

Additional information may be obtained from C. M. Hewitt, Chairman of Subcommittee B-26 on Effect of Water on Bituminous Coated Aggregates of ASTM Committee D-4, Mexican Petroleum Corporation, Box 1417, Baltimore 26, Md.

National Essay Contest on Weldments

THE Pandjiris Weldment Co. of St. Louis, Mo., is sponsoring a national essay contest on the advantages of positioning weldments, the welding head, the welder, or a combination. The contest will run through midnight April 30, 1954 and prizes will be as follows:

First prize	$500
Second prize	$250
Third prize	$150
Fourth prize	$ 50
Fifth prize	$ 50

A three-man board of prominent men in the welding field will judge the papers. Winners will be announced before the end of the first half of 1954. A set of rules and entry blanks can be obtained from Phil Sackbauer, The Pandjiris Weldment Co., 5151 Northrup Ave., St. Louis 10, Mo.

American Association of Spectrographers

THE American Association of Spectrographers is presenting a symposium on "Direct Reading Emission Spectroscopy," to be held in Chicago, May 7, 1954. This will be broken down into the following subtitles: iron and steel, non-ferrous metals, and metal in nonmetallic materials. Contributed papers are welcome. Please address inquiries to: M. E. Slagel, U. S. Reduction Co., Box 30, East Chicago, Ind.

Proposed Method of Test for Measuring the Static Coefficient of Friction of Waxed Floor Surfaces

The measurement of antislip properties of smooth surface floors has been a problem of long standing. ASTM Committee D-21 on Wax Polishes and Related Materials has undertaken to establish standards in this field of performance or simulated service type of testing in evaluating emulsion type floor waxes. Realizing the many problems involved due to the great number of variables induced in such a test, the committee has presented as its first efforts in this direction the following two proposed methods of test which are published for information only. The two types of apparatus involved also represent a great deal of research and testing on the part of the individual sources of this equipment, namely, the National Bureau of Standards and the Underwriters' Laboratories.

Comments are solicited and should be addressed to the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Scope:

1. This method of test covers a procedure for the measurement of the static coefficient of friction of floor surfaces. The apparatus is not suitable for use on wet, rough, or corrugated surfaces.

Apparatus:

2. The testing apparatus known as the James Machine[1] (Fig. 1), shall be used. The shoe shall be faced with sole leather,[2] and sanded to a smooth, flat surface with No. 400-A wet or dry carborundum paper.[3]

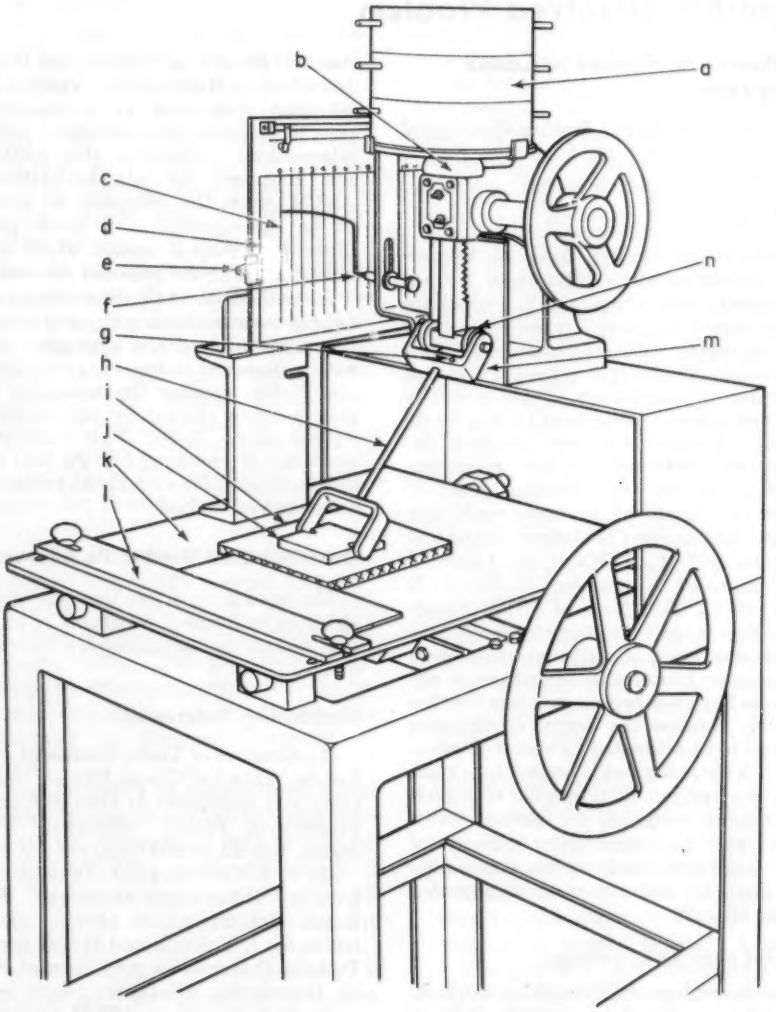
Test Panels:

3. (*a*) Flooring panels not less than 6 by 6 in. shall be used. Thin or flexible panels shall be mounted on a rigid base to prevent buckling.

(*b*) For interlaboratory and specification testing, TOTL[4] is recommended. These panels shall be mounted, buffed with No. 00 steel wool to a 60-deg specular gloss of 7 to 8 as determined by the Tentative Method of Test for Specular Gloss (ASTM Designation: D 523),[5] dusted off, rinsed with water, and dried. With a correctly adjusted machine and shoe, these panels should have a coefficient of friction between 0.9 and 1.0.

Preparation of Test Surface:

4. Flood the panel with the wax to be tested, and place it in an approximately vertical position. At the end of 10 min, wipe off the bead at the bottom of the panel, and allow the panel to dry in a vertical position for 2 hr at 75 ± 2.5 F and 50 ± 4 per cent relative humidity. Apply a second coat in the same manner, but dry it in the reverse direction for 18 to 24 hr. The panel is then ready for testing.



a—Weights
b—Cushion
c—Chart
d—Chart Board
e—Spring Clip
f—Recording Pencil
g—Set Screw
h—Strut
i—Specimen
j—Shoe
k—Test Table
l—Retaining Bar
m—Back Plate
n—Ball Bearing Rollers

Fig. 1.—The James Machine.

[1] This machine was developed by S. V. James of the Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago 11, Ill. Blueprints of the machine may be obtained from the Underwriters' Laboratories, and machines may be purchased from Gilbert & Neilson Machine Co., 2525 Lathrop Ave., Racine, Wis.

[2] This material is available from Armour & Co., Chicago, Ill., as Armour Prime Sylva (Prime Sole Leather Back).

[3] This material is available from the Minnesota Mining & Mfg. Co., 900 Fauquier Ave., St. Paul, Minn.

[4] TOTL is the Tentative Official Test Linoleum (1952) of the Chemical Specialties Manufacturers Assn., 110 E. 42nd St., New York 17, N. Y., and may be obtained from them.

[5] 1953 Supplement to Book of ASTM Standards, Part 4.

Preparation of Leather Shoe:

5. To prepare the leather shoe, place a sheet of 400-A wet or dry carborundum paper on the laboratory bench. Sand the shoe gently by moving four times back and forth about 4 in. Repeat at an angle of 90 deg. The performance characteristics of the shoe should be checked regularly. Make certain that all of the dust is removed.

Procedure:

6. (*a*) The test shall be conducted in a room maintaining the standard conditions of temperature and humidity given under Section 4.

(*b*) Carefully level the machine in all directions. With the large handwheel move the test table to the right against the stop. Insert the chart on the chart board (see Fig. 1) and adjust to the zero line. With the small handwheel raise the column until the strut is vertical. Check this with a machinist's level. Make sure the rollers are in firm contact with the back plate. Adjust the set screw if necessary. Check alignment of the chart and adjust to zero at both top and bottom.

(*c*) Place the specimen panel on the test table against the retaining bar, insert the shoe in the yoke, and release the recording pencil.

(*d*) With the large handwheel slowly advance the test table until the shoe slips and the vertical column drops.

(*e*) Estimate the coefficient of friction to the nearest 0.01 at the top of the vertical drop line (see Fig. 1), and record.

Accuracy:

7. (*a*) In any series of tests the range shall not exceed 0.07. Results of greater variation than this shall be discarded. Unless three out of four tests on the panel are within the allowed variation, another test panel shall be prepared.

(*b*) This method should give an accuracy of ±0.05 provided standard test panels are used. In most cases the results are significant only to the first decimal place.

Report:

8. Report the results as static coefficient of friction.

Proposed Method of Test for Measuring the Dynamic Coefficient of Friction of Waxed Floor Surfaces

Scope:

1. This method of test covers a procedure for the measurement of the dynamic coefficient of friction of floor surfaces. The apparatus is not suitable for use on rough or corrugated surfaces.

Apparatus:

2. (*a*) The testing apparatus known as the Sigler Pendulum-Impact Type Slipperiness Tester[1] shall be used. This instrument can be employed for measurement of antislip properties of any floor, since it can be used wherever a plain level surface has an area great enough to accommodate the instrument. However, for those persons engaged in research on floor-finishing materials, its main use will be as a laboratory instrument for evaluating small test panels. The use of the instrument in the field, for evaluation of walkway surfaces in actual use, requires techniques varying only slightly from those involved in the laboratory methods.

(*b*) Figures 1 and 2 show the details of the mechanical construction of the instrument, which is so constructed that the effective length of the pendulum is 17.0 in. (distance from the center of oscillation to the center of gravity of the pendulum). The quadrant attached to the back of the rack is positioned so that, after proper adjustment of the pointer contact arm, the pointer registers the height of the center of gravity of the pendulum.

Preparation of the Heel:

3. (*a*) The test heel shall be a piece of leather, $1\frac{1}{2}$ in. square and $\frac{1}{4}$ in. thick, conforming to the requirements for type I or factory leather in Federal Specification KK-L-261c: Leather, Sole; Vegetable-Tanne.[2] In addition, the compressibility of the leather shall be between 4 and 8 per cent, as determined by the method described in the Federal specification.

(*b*) The lower end of the pendulum shall be arranged so that the heel material is held, by means of a metal strap, at an angle of 20 deg with horizontal, and only the rear edge of the heel contacts the test surface.

(*c*) *It is important that the heel edge be prepared in the proper manner.* The edge of the heel should be rounded slightly by light sanding with No. 400-A wet or dry carborundum paper,[3] so that the area of contact measures $^1/_{16} + ^1/_{32}$ in. wide and $1^1/_2$ in. long. *If the area of contact is too great, high values of the dynamic coefficient of friction, U, will be obtained; if the area of contact is too small, low values of U will be obtained.*

(*d*) Repeated use of the same heel will eventually wear the heel to a point where the contact area is too great, and a new heel then must be prepared; or the heel can be turned to expose a new working edge.

(*e*) Where certain specific antislip properties are desired, other materials, such as rubber, wood, or various synthetic sole substances can be used. The same precautions still must be observed in preparing the contact edge of the heel.

Test Panels:

4. (*a*) Flooring panels not less than 6 by 6 in. shall be used. Thin or flexible panels shall be mounted on a rigid base of $\frac{5}{8}$ plywood to prevent buckling.

(*b*) For interlaboratory and specification testing, TOTL[4] is recommended. These panels shall be mounted, buffed with No. 00 steel wool to a 60-deg specular gloss of 7 to 8 as determined by the Tentative Method of Test for Specular Gloss (ASTM Designation: D 523),[5] dusted off, rinsed with water, and dried. With a correctly adjusted machine

[1] Several instruments have been manufactured by Sherman W. Frazier, 953 15th St., S.E., Washington 3, D. C., and some have been assembled in other shops.

[2] This material is available from the American Oak Leather Co., Cincinnati, Ohio, as No. 1 Extra Heavy Oak, Factory Bend.

[3] This material is available from the Minnesota Mining & Mfg. Co., 900 Fauquier Ave., St. Paul, Minn.

[4] TOTL is the Tentative Official Test Linoleum (1952) of the Chemical Specialties Manufacturers Assn., 110 E. 42nd St., New York 17, N. Y., and may be obtained from them.

[5] 1953 Supplement to Book of ASTM Standards, Part 4.

and heel, these panels should have a coefficient of friction between 0.4 and 0.5.

Preparation of Test Assembly:

5. (*a*) For laboratory use, place the apparatus on a firm heavy table or laboratory bench at a comfortable working height. Rest the instrument on a level steel plate, $\frac{3}{8}$ in. thick, about 23 in. long, and 10 in. wide. This plate forms a firm base for the panel to be tested. The panel must be held securely, so that it will not slide under the impact of the pendulum. When many test panels are involved, the method of securing the panels to the steel plate should be such as to facilitate the changing of panels.

NOTE.—One simple method for securing the test panel to the steel base plate is to fasten two parallel steel bars, 12 in. long, and 3 in. apart, to the base plate with two pairs of set screws. When the set screws are loosened, the bars can be raised and the panel inserted. When the set screws are tightened, care should be used to flatten the test surface with the block of wood while tightening the fastener arms. This is especially important with flexible materials, such as linoleum, which tends to warp after washing. After an impact has been made on the area exposed, the fastener bars can be loosened, and the panel changed to expose a new area for testing.

(*b*) In aligning the fastener bars in the direction of the swing of the pendulum, take care that the foot of the pendulum does not strike either of the fastener bars.

Procedure for Measuring the Antislip Coefficients of Test Panels:

6. (*a*) Mount the test panel securely under the two fastener bars, making sure that the test surface is perfectly flat.

(*b*) By means of the leveling screws adjust the height of the instrument to a position *where the test heel, with the $\frac{1}{8}$-in. spacer between strap B and the stop, will not touch the test surface.*

(*c*) Level the instrument, using the spirit level, in the direction of the swing of the pendulum and so that the edge of the heel is parallel to the surface of the test material in the direction perpendicular to the swing. This step is most easily accomplished by sighting toward a beam of light between the heel edge and the surface.

(*d*) Place the pendulum in the starting position, and place the pointer against the contact arm. The pointer should indicate *10*. Then release the pendulum, and note the reading of the pointer at the end of the swing. This value is *H*, the effective height of the center of gravity of the pendulum, and should be checked a few times before proceeding to the next step.

(*e*) Adjust the height of the instrument so that the edge of the heel just contacts the test surface when the $\frac{1}{8}$-*in. spacer is between strap B and the stop*. This adjustment is made so that the scale reading at the end of a test swing is *now 0.1 less than the value of H*. It is important that this drop due to slight contact shall be *neither greater nor less than 0.1 in.*

(*f*) After the required adjustments have been made, sand the working edge of the heel *very lightly* with 3/0 abrasive paper to remove the thin film of test surface material picked up during the test swings. Then brush the heel edge and the test panel thoroughly to remove any particles of abrasive.

(*g*) Remove the $\frac{1}{8}$-in. spacer and place the pendulum and pointer in the starting position. At this point, place determine *h*, the height of the center

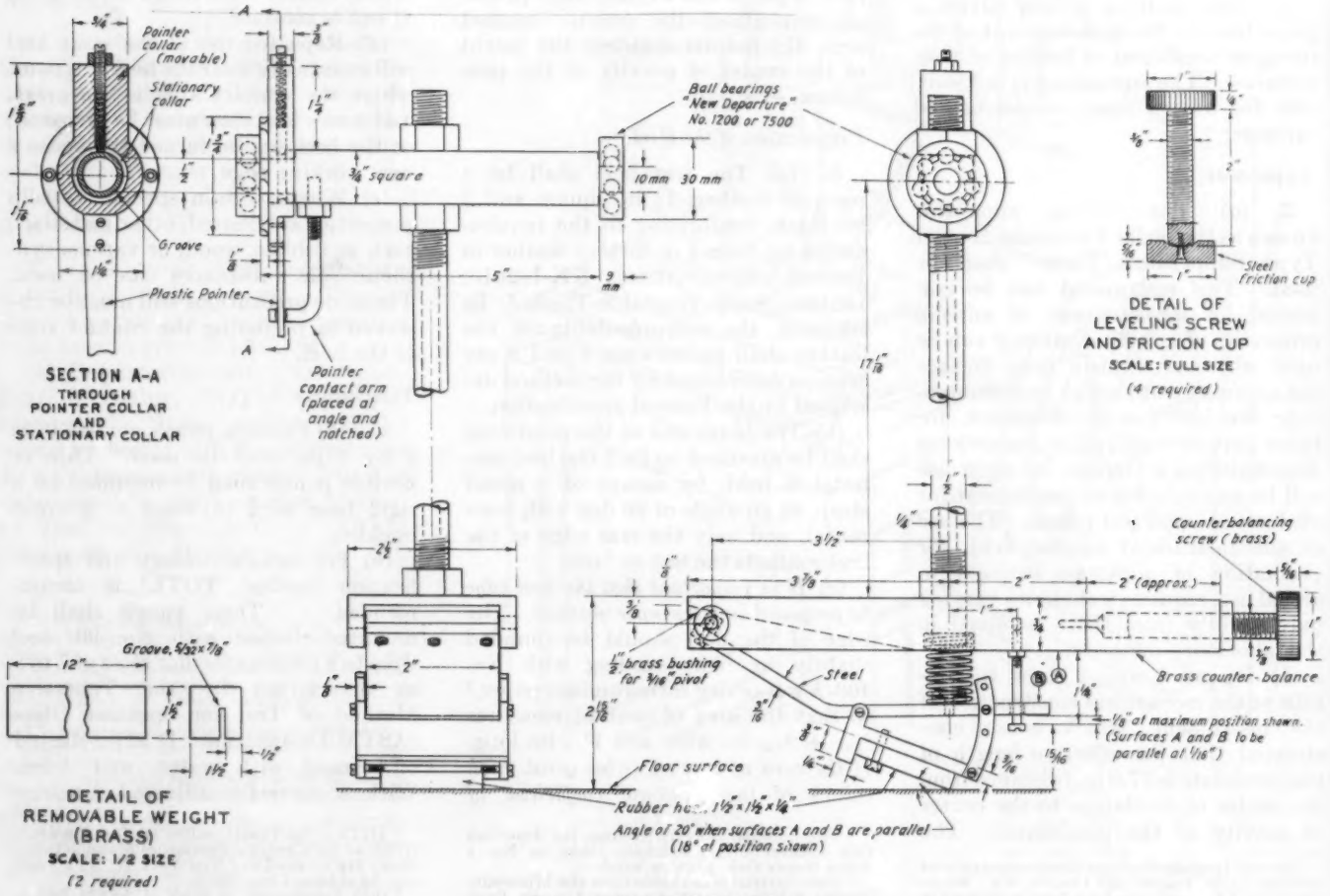

Pointer collar (movable)
Stationary collar
Groove
Plastic Pointer
SECTION A-A THROUGH POINTER COLLAR AND STATIONARY COLLAR
Pointer contact arm (placed at angle and notched)
Ball bearings "New Departure" No. 1200 or 7500
¾" square
10 mm 30 mm
5"
9 mm
17 1/8"
DETAIL OF LEVELING SCREW AND FRICTION CUP
SCALE: FULL SIZE
(4 required)
Steel friction cup
Counterbalancing screw (brass)
3 1/2"
3 7/8"
2" (approx.)
½" brass bushing for 3/16" pivot
Steel
Brass counter-balance
1/8" at maximum position shown. (Surfaces A and B to be parallel at 1/16")
Floor surface
Rubber heel, 1½" x 1½" x ¼"
Angle of 20° when surfaces A and B are parallel (18° at position shown)
Groove, 5/32" x 7/8"
12"
DETAIL OF REMOVABLE WEIGHT (BRASS)
SCALE: 1/2 SIZE
(2 required)

Fig. 1.—Detail of Pendulum

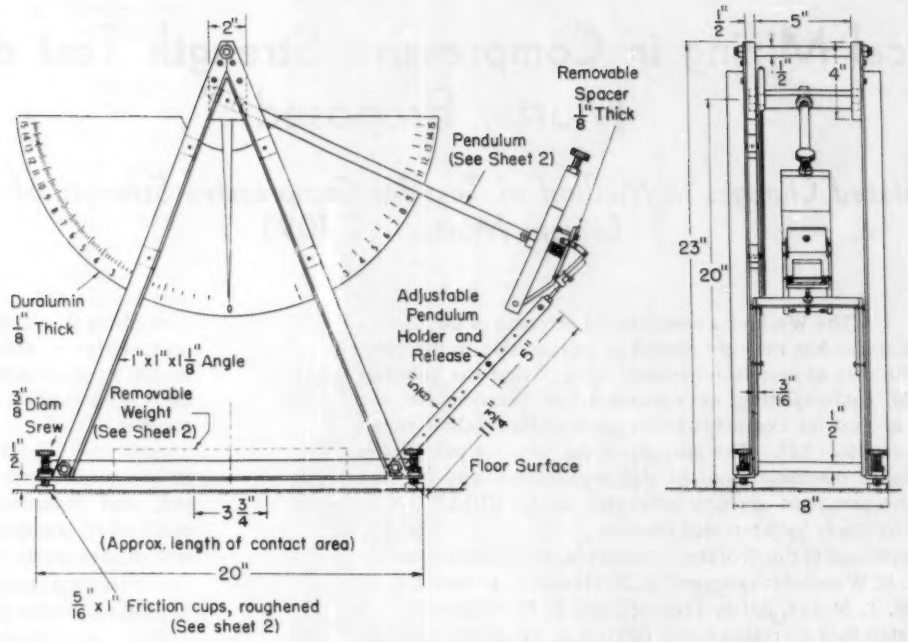


Fig. 2.—Construction of Machine.

of gravity of the pendulum *after* the end of a swing in which the heel has contacted the walkway surface, as follows:

(*1*) Have the left hand ready to catch the pendulum just after it has started to drop from its highest position at the end of the swing. *This is necessary because, without the 1/8-in. spacer, the heel would damage the test on the reverse swing of the pendulum.*

(*2*) With the right hand, release the pendulum from its starting position and catch the pendulum, as described in Item (*1*), with the left hand. The position of the pointer corresponds to *h*. *Take care in catching the pendulum with the left hand that the position of the pointer is not disturbed.* This may require considerable practice.

(*3*) Return the pendulum to its original starting position, being careful to reach *under* the foot to *compress the spring*, so that the heel will not scratch the test surface to a marked degree. Sand the heel edge lightly, to remove the film of finish picked up by the heel during contact with the test panel, and brush to remove the abrasive. This narrow film of finish is easily visible, and constant observation of its width will indicate whether the contact area is that specified in Section 3 (*c*).

(*h*) Replace the 1/8-in. spacer, and change the position of the test panel so that a new test area is exposed.

(*i*) Repeat the above steps in the determination of *h* on successive areas of the test panel, until checks of about 0.1 to 0.2 are obtained. Record the average value.

Calculation of Antislip Coefficients:

7. Using the average value of *h*, and the constants for the instrument, calculate *U* as follows:

$$U = \frac{W(H - h)}{DP}$$

where:

U = antislip coefficient, or dynamic coefficient of friction,
W = weight, in pounds, of the unbalanced portion of the pendulum,
H = effective height, in inches, of the center of gravity of the pendulum (or the height to which the unimpeded pendulum will swing),
h = height of the center of gravity of the pendulum *after* the end of a swing in which the heel has contacted the walkway surface,
D = distance of contact, in inches, of the heel against the walkway surface, and
P = average force, in pounds, exerted by the helical spring in pressing the edge of the heel against the walkway surface.

NOTE: *Example.*—For the instrument used in this test:

$W = 3.15$
$D = 3.81$
$P = 6.52$
$H = 9.80$

Therefore:

$$U = \frac{W(H - h)}{DP} = \frac{3.15(9.80 - h)}{(3.81)(6.52)} =$$

$1.243 - 0.127h$

h (for asphalt tile) = 5.76, 5.78, 5.70
Average h = 5.75
$U = 1.243 - 0.127(5.75) = 1.243 - 0.730 = 0.513$
Rounded to $U = 0.51$

Report:

8. Report as dynamic coefficient of friction (Sigler machine) an average of not less than four determinations.

Mechanical Mixing in Compressive Strength Test of Cement Mortar Proposed

Contemplated Changes in Method of Test for Compressive Strength of Hydraulic Cement Mortars (C 109)

The Working Committee on Strength of Committee C-1 on Cement has recently offered as information to the committee the text of certain important changes that the subcommittee is contemplating as recommended revisions in the Method of Test for Compressive Strength of Hydraulic Cement Mortars (C 109 – 52). The purpose of the advance publicity is to encourage discussion and helpful suggestions, and for that reason the proposals are now presented in the BULLETIN as material for study by interested readers.

The personnel of the Working Committee on Strength is as follows: C. E. Wuerpel (chairman), R. F. Blanks, C. L. Davis, L. C. Hawk, W. T. Moran, Bailey Tremper, and T. M. Whiteside. It is suggested that correspondence relative to the above contemplated changes be addressed to C. E. Wuerpel, Technical Director, Marquette Cement Manufacturing Co., 20 North Wacker Drive, Chicago 6, Ill., or to Society Headquarters at 1916 Race St., Philadelphia 3, Pa.

THE proposed revisions in Method C 109 are intended to substitute *mechanical mixing* for the *manual mixing* now employed in preparing the standard test mortars, and to effect certain *desired refinements* in various details of test procedure. The proposed changes are:

Section 2(*f*).—Reword to read as follows:

(*f*) "*Mixer, Bowl, and Paddle.*—The mixer shall be an electrically driven mechanical mixer of the type equipped with paddle and mixing bowl, as specified in Section 2(*a*), (*b*), and (*c*), respectively, of the Tentative Method for Mechanical Mixing of Hydraulic Cement Mortars of Plastic Consistency (ASTM Designation: C 305 – 53 T)."

Section 5(*b*).—Reword, so as to provide for refinement in testing the sand, and cover the use of mechanical sieving. Revised test to be as follows:

(*b*) "The test on each sieve shall be made with approximately 100 g of sand. The selection of an exact predetermined weight shall not be attempted. The sieving operations shall be performed in the manner specified for sieving cement in the Standard Method of Test for Fineness of Hydraulic Cement by the No. 200 Sieve (ASTM Designation: C 184), except that sieving shall be continued until not more than 0.5 g passes through in 1 min of continuous sieving. The weight of the residue on the sieve shall be expressed as a percentage of the weight of the original sample.

"Mechanical sieving devices may be used but the sand shall not be rejected if it meets the requirements when tested by the hand method (ASTM Designation: C 184)."

Footnote 6.—Change numbering and reword, as shown below, to provide more suitable suggested trial limits for the amounts of mixing water; provide "Note" reference in Section 8(*a*):

"NOTE.—As a guide for the initial trial mortar, the percentage of water by weight of the cement to produce the specified flow will be about 46 to 49 per cent for portland cement containing air-entraining material and about 49 to 50 per cent for portland cement not containing air-entraining material."

Section 8(*b*).—Reword as shown here in order to be consistent with the revised Section 2(*f*) wherein mechanical mixing is required.

(*b*) "Mixing shall be done mechanically in accordance with the Tentative Method for Mixing of Hydraulic Cement Mortars of Plastic Consistency (ASTM Designation: C 305 – 53 T) by the Procedure given in Section 5 thereof. Upon completion of mixing, the mixing paddle shall be shaken to remove excess mortar into the mixing bowl."

Section 9.—Delete the present second sentence that relates to the removal of mortar from glove employed in the current manual mixing of the mortar.

Section 10.—In order to make proper reference to the mechanical mixing, and secure improvement in the method of molding the mortar cubes, reword the section to read as follows:

"10. Immediately following completion of the flow test, the mortar from the flow mold shall be returned to the mixing bowl and the entire batch shall be given a 15-sec mixing at medium speed. (NOTE.—When a duplicate batch is to be made immediately for additional cubes, the flow test may be omitted and the mortar allowed to stand in the mixing bowl for 90 sec and then remixed for 15 sec at medium speed before starting the molding of the cubes.) Within a total elapsed time of not more than 2 min and 15 sec after completion of the original mixing of the mortar batch, molding of the cubes shall be started. A layer of mortar about 1 in. in thickness shall be placed in all of the cube compartments. Then the mortar in each cube compartment shall be tamped (Section 2 (*i*)) 32 times in about 10 sec in four rounds, each round to be at right angles to the other and consisting of eight adjoining strokes over the surface of the specimen, as illustrated in Fig. 1. The tamping pressure shall be just sufficient to insure uniform filling of the molds. The four rounds of tamping (32 strokes) of the mortar shall be completed in one cube before going to the next. When the tamping of the first layer in all of the cube compartments is completed, the compartments shall be filled with the remaining mortar and then tamped as specified for the first layer. During tamping of the second layer the mortar forced out onto the tops of the molds after each round of tamping shall be brought in by means of the gloved fingers and tamper upon completion of each round and before starting the next round of tamping. On

completion of the tamping, the tops of all cubes should extend slightly above the tops of the molds. The mortar which has been forced out onto the tops of the molds shall be brought in with a trowel and the cubes smoothed off by drawing the flat side of the trowel (with the leading edge slightly raised) once across the top of each cube at right angles to the length of the mold. Then, for the purpose of levelling the mortar and making the mortar that protrudes above the top of the mold of more uniform thickness, the flat side of the trowel (with the leading edge slightly raised) shall be drawn lightly once along the length of the mold. The mortar shall then be cut off to a plane surface flush with the top of the mold by drawing the straight edge of the trowel (held nearly perpendicular to the mold) with a sawing motion over the length of the mold."

Section 11.—Revise the current first sentence to read:

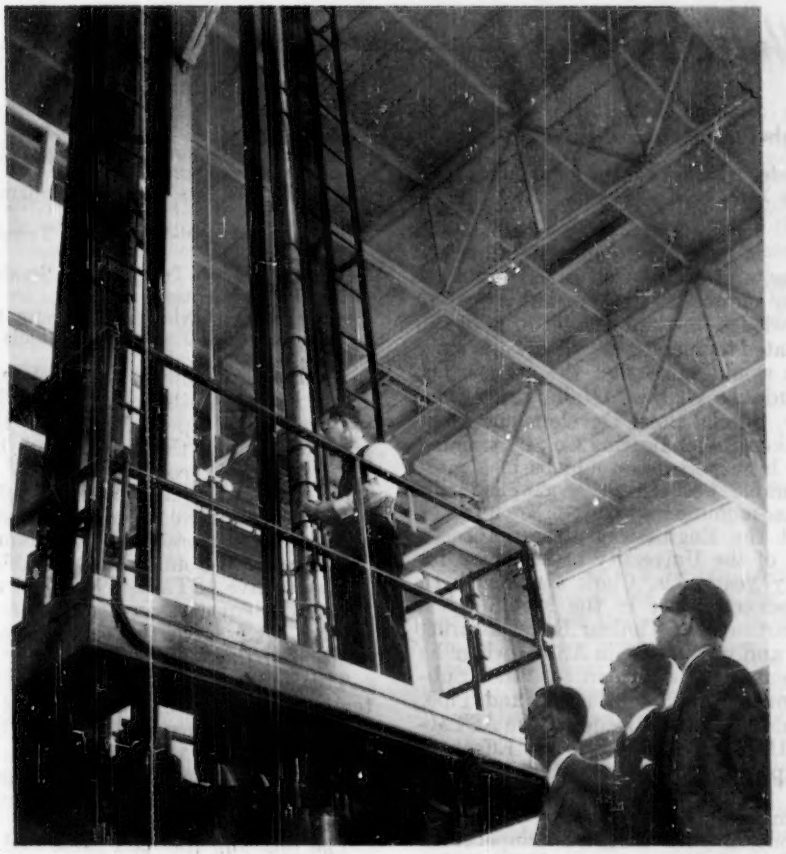
"11. Immediately upon completion of molding the test specimens shall be placed in the moist closet or moist room. All test specimens shall be kept in the molds on the base plates in the moist closet or moist room from 20 to 24 hr with their upper surfaces exposed to the moist air but protected from dripping water."

Section 12(*a*).—In the present third sentence, replace the words "placed in a pan of water" by the words "kept in water."

Delete current Fig. 1, showing the bowl used in the manual mixing of mortar. Renumber the current Fig. 2 as Fig. 1.

Move the present Footnote 6, revised as above, and the notes now at the end of the test method, to appropriate places in the text where they apply, making proper changes in numbering and inserting references to the notes at those points in the text to which the notes apply.

STANDARDIZATION is the liberator that relegates the problems that have already been solved to their proper place—the field of routine—and leaves the creatives facultie free for the problems that are still unsolved.



Here is a rather unusual shot of an aluminum cable strung for testing in a three-story high tension testing machine at the Hastings Laboratories of Anaconda Wire and Cable Co. The cable is stretched to the breaking point in the device, which can exert up to 200,000 lb pull. The tension tester, a multi-purpose instrument, records (*a*) stress-strain on the cable, (*b*) strain time elapsed, (*c*) multi-point temperatures, (*d*) is equipped with a constant load maintainer, and (*e*) has a loading rate indicator. Electric eye mechanism, at knee-level, protects technicians on the floor when platform is raised by freezing it in position. Watching, on the right, is ASTM's Art Jones.

More Kilowatts for Government Projects

THE largest capacity boiler with the highest pressure and temperature ever sold in the State of New Mexico is now being built by The Babcock & Wilcox Co. for the Person Station of the Public Service Co. of New Mexico at Albuquerque.

To be installed in the station situated at the foot of the Sandia Mountains, this outdoor unit will generate steam to produce 35,000 kw of electricity, a large part of which is for the use of the Atomic Energy Commission and the Secret Weapon base at Sandia. The addition of the new unit will increase the Public Service Co.'s total capacity to approximately 127,000 kw.

Producing steam at 305,000 lb per hr, which can be raised to 335,000 lb at 4-hr peak periods, the new boiler will operate at a pressure of 875 psi at a temperature of 910 F. The trend today in steam generation to higher and higher pressures and temperatures is permitting more efficient use of steam by turbines.

The new unit is designed for pressure-firing. Because of the great size and complexity of the boiler, which is more than five stories high, it will require until November, 1954 to engineer, build, and erect the unit and get it into operation.

The new installation is a part of a three-year, $22,000,000 expansion program being carried out by Public Service Co. of New Mexico to meet the electric light and power needs of the area.

The utility company points out that, in Albuquerque and the surrounding area, the past 10 years have brought a sudden rise in the population, an expansion of older industries, and the development of new industries, due partly to the installation of military and Government agencies and partly to the decentralization of industry from larger metropolitan areas.

The Bookshelf

High-Temperature Alloys

Claude L. Clark, Pitman Publishing Co., New York, N. Y., 396 pp., $7.50

THE author of this book, one in the Pitman Metallurgical series, states that the primary purpose is to summarize the current status of knowledge on the behavior of alloys in elevated temperatures. There are many who would agree that the author, Dr. Claude L. Clark, Metallurgical Engineer, Special Steel Developments, The Timken Roller Bearing Co., by training and by experience would be in a most favorable position to accomplish this rather monumental task.

At the Engineering Research Institute of the University of Michigan for many years, Dr. Clark also has been for several years in the Metallurgical Department of Timken Roller Bearing Co., and very active in ASTM where he currently is chairman of the Subcommittee on Steel Tubing and Pipe. He also has been a leader in the ASTM-ASME Joint Committee on Effect of Temperature and currently is Chairman of the Panel on Petroleum and Chemical Products.

Concern with elevated temperature problems became evident about 1925, and, of course, in the last ten years the interest has been greatly intensified. The designer, most anxious to improve his operating efficiency, has pushed the metallurgical engineer to develop materials to stand higher temperatures and pressures and particularly to withstand higher temperatures and stresses over long periods of time.

The book stresses the engineering rather than the theoretical aspect. It is replete with illustrations, many well-chosen half-tones, charts, diagrams, and tables; in fact, the charts and tables may appeal to many as the book's outstanding characteristic because they provide in compact, readily understandable form a perspective of our current information.

A list of chapter headings will give some concept of the coverage:

Temperature Trends in Industry
Mechanism of Plastic Deformation
Qualifications of Alloys for High-Temperature Service
Laboratory Methods for Evaluating High-Temperature Alloys
Short-Time Tests for Indicating High-Temperature Strength
Factors Influencing the Creep Strength
Relative Advantages of Creep and Stress-Rupture Tests
Relative Merits of Methods for Evaluating Load-Carrying Ability
Influence of Alloying Elements
Introduction to Present-Day High-Temperature Alloys
Low-Alloy Steels
Intermediate-Alloy Steels
Straight Chromium Stainless Steels
Austenitic Stainless Steels
Bolting Steels
Super-High-Temperature Alloys
Representative Service Failures
Physical Constants of High-Temperature Steels
Properties at Hot-Processing Temperatures
Selection of High-Temperature Steels for Specific Applications
Specifications, Codes, and Committees Covering High-Temperature Steels

There are, of course, many references in the work to both ASTM and ASME, as would be expected because these societies, through their committees, have made valuable contributions to our knowledge of this field, and the ASTM specifications have been an effective guide and a safe practice. For example, Dr. Clark gives an extensive table of representative ASTM specifications with the grades covered, and then more extensive tables give the chemical composition of the ASTM alloys.

This subject of materials for high-temperature service will be one of increasing significance. It is well to have an authoritative publication of this kind which summarizes the really great amount of information already available, but scattered.

The text and the data presented are well organized, and a detailed index is provided. There is a condensed list of references for the reader.

• • •

50–100 Binomial Tables

Harry G. Romig, John Wiley & Sons, Inc., 440 4th Ave., New York, N. Y., 172 pp., $4.

IN MAKING evaluations of the probabilities connected with various sampling procedures in the past, it has been necessary to use approximate values of the p binomial. Exact values are provided in this book, one of the Wiley Publications in Statistics, edited by Walter A. Shewhart, which presents tables for the positive binomial $(q + p)^n$ where $q = 1 - p$. It covers the range of n values from 50 to 100 in steps of 5 and the range of p values from 0.01 to 0.99 in steps of 0.01, and includes a brief summary of the information needed to use these tables.

These tables can be used widely both within and outside the quality control field, their usefulness having been increased by the provision of other relations for which no probability values may be obtained, and a brief discussion of interpolation.

Prepared by Dr. Romig, ASTM member, who is now Quality Manager, Hughes Aircraft Co., these values were computed on a General Purpose Digital Computer at Bell Telephone Laboratories.

Building Specifications

H. Griffith Edwards, D. Van Nostrand Co., New York, N. Y.

THIS manual of specification writing for architects and builders is intended by the author as a primer. Good specification writing, designed as a guide to students and young architects as well as to help the more experienced who wish to raise the standard of their specification writing.

Part 1 deals with the general aspects of specification writing. Part 2 goes into the conditions and specific trades involved in specification writing for non-fireproof types of construction. In Part 2 there are chapters on earthwork, concrete, masonry and waterproofing, metal work, carpentry, roofing, flooring, plumbing, heating, etc.

It is unfortunate that the author had to limit the scope of his book in Part 2 to the presentation of specifications for a residence only. He does point out that specification writing is a broad field and to cover all its facets would require many volumes. He further points out that the fundamental principles presented are applicable to larger jobs, fireproof and semifireproof construction, as well as to buildings of a specialized nature such as hospitals and jails where more detailed specifications are required.

Numerous data tables are included along with standard wordings of specifications, bid forms, contracts, etc.

• • •

Electron Microscopy Bibliography

THE New York Society of Electron Microscopists has started to issue a bibliography on Keysort cards (3.3 by 7.5 in.) which will keep abreast of the world literature in all fields of electron microscopy. An outstanding feature of this bibliography is its ease of use. The first issue covering the years 1950, 1951, and 1952 (approximately 700 cards) is now available. Early publication of material for 1953 and quarterly publications on current literature thereafter are planned. Supervised by a trained bibliographer, the Society draws upon the exceptional library resources of the New York area. All material is examined for accuracy of reference and for subject content.

The present phase of the work has been supported by a grant from the Lillia Babbitt Hyde Foundation. In 1954, the bibliography is being continued with the aid of donations from the Farrand Optical Co., the North American Philips Co., the Optical Film Engineering Co., and the Radio Corp. of America.

Physical and Thermodynamic Properties of Hydrocarbons

Carnegie Press, Carnegie Institute of Technology, Pittsburgh, Pa., 1000 pp., $7

By the end of 1952 API's Research Project 44 had completed 10 years' work. This volume represents the current fruit of the Project.

The aims of the Project have been and are to examine the original data in the literature, plus unpublished data, and to appraise them critically; to correlate values of given properties, with temperature or pressure to obtain values for temperatures or pressures for which no data are available, and with molecular structure to obtain values for compounds for which no data are available; to make original calculations of thermodynamic and physical properties as necessary; to select and tabulate "best" values of the properties; to prepare the selected values in a convenient form for use by industrial and scientific laboratories; to publish descriptions of the original calculations and correlations; and to keep the tables of selected values of properties up-to-date with revisions at appropriate intervals.

The properties being investigated include the following: boiling point, and pressure coefficient of the boiling point, at 1 atm.; refractive index at 20 and 25 C; density at 20 and 25 C; specific gravity at 60 F; freezing point, in air at 1 atm, in deg Cent and deg Fahr; molecular volume, molecular refraction, specific refraction, refractivity intercept, and specific dispersion, at 20 and 25 C; viscosity at centipoises, for the normal liquid range, at given temperatures in deg Cent; kinematic viscosity, in centistokes, for the normal liquid range, at given temperatures in deg Cent and Fahr; vapor pressures and boiling points, in deg Cent, at 10 to 1500 mm pressure, and, in deg Fahr, at 0.2 to 31 psi pressure; critical pressure, temperature, density, volume, and compressibility factor; surface tension at various temperatures; P-V-T and related properties; heat of vaporization at 25 C and, at the normal boiling point, at 1 atm; entropy of vaporization at the normal boiling point; heat of combustion, at 25 C, for both the liquid and gaseous states, in kilocalories per mole, calories per gram, and Btu per lb; heat of formation, entropy, calories per gram, and Btu per lb; heat of formation, and free energy of formation, in kilocalories per mole, and free energy of formation, at 25 C, for both the liquid and gaseous states; standard heat, entropy, and free energy of vaporization, at 25 C; heat-content function, free-energy function, entropy, and heat capacity, for the ideal gaseous state, to high temperatures and calories per degree mole; heat content for the ideal gaseous state, to high temperatures and calories per mole, and the logarithm of the equilibrium constant of formation, for the ideal gaseous state, to high temperatures; the cryoscopic constants (first and second), freezing point at saturation pressure (triple point) and in air at 1 atm, and heat and entropy of fusion.

The Project covers hydrocarbons of all types and molecular weights, and all nonhydrocarbon compounds of importance to the petroleum industry. The latter include organic sulfur compounds, organic oxygen compounds, simple nitrogen compounds, and certain halogens and halogenated hydrocarbons.

The extent of the coverage of the scientific and technical literature by the Project is indicated by the number of papers included in the list of references—well over 2500.

The tables already compiled by the API Research Project 44 are printed on loose-leaf sheets, 8 by 10½ in. in size, one side only, and are distributed once or more each year, as prepared; the distribution each year includes revisions of previously issued tables as well as new tables.

• • •

Introductory Soil Mechanics and Foundations

Soiltest, Inc., 4520 W. North Ave., Chicago 39, Ill., 284 pp., $5.

Introductory Soil Mechanics and Foundations, by George B. Sowers and George F. Sowers, who is a member of ASTM Committee D-18 on Soils for Engineering Purposes, is written as a scientific approach to soil and foundation problems. It is designed to serve as a source of soil information for civil and architectural engineering students as well as the practicing engineer.

The book discusses the geology, classification, and physical properties of soil. The latter portion discusses soil engineering problems and their solution, and includes illustrative and practice problems.

• • •

Weldability of Steels

Robert D. Stout and W. D'Orville Doty, Welding Research Council, 29 W. 39th St., New York, N. Y., 381 pp., $6.50

Publication of this monograph represents the culmination of a project sponsored by the Welding Research Council to assemble, study, and condense the research findings of the multitude of individual research investigations into the field of weldability of steels as it involves their mechanical and metallurgical properties and structural design.

In providing a summary and critical analysis of the broad general results of these investigations, the authors present the fundamentals of welding processes and metallurgy; the basic factors which influence weldability; and suggested methods for welding commonly used in steels. The concluding chapters contain a review and critical evaluation of weldability tests and general conclusions on present knowledge of weldability.

Probably the most widely useful part of the book is a 50-page appendix consisting of tables classifying all standard specifications steels such as ASTM, SAE, and ABS, into three categories: those which are readily weldable; those in which some precautions are needed; and those which require special precautions and considerations. Exact welding procedures are indicated for each thickness of steel.

• • •

Timers

M. G. Saake, Ribble Engineering Co., 74 Montgomery St., Jersey City, N. J., 236 pp., $5

Many a design engineer has spent considerable time in the past getting together the necessary information when in his project the question of timing and timers developed. But now to help such an engineer, Myrten G. Saake has written a book which he claims to be the first complete full-length reference book on industrial timers and their application. He covers basic design, selection, and application—with emphasis on how to do it; he explains timers in their simplest to most complex forms by the use of numerous circuit diagrams. A chapter on automatic counting has been included.

The author's treatment is descriptive. Along with the circuit diagrams he has included numerous photographs of actual timers and timing systems. While the book should be of some interest to students and to research and production engineers, it should find its greatest use in the hands of the process designer.

• • •

Midwest Inspection Journal—1953 Directory Issue

Midwest Conference of Building Official and Inspectors, 207 Holliday Building, Indianapolis, Ind., 68 pp., $10

The 1953 directory of public officials of the Midwest States who administer and enforce codes and regulations governing building construction has just been released by the Midwest Conference of Building Officials and Inspectors. The new directory also lists the type of codes under which the governmental agency regulates building, plumbing, electrical, heating, and related subjects. Where the information has been obtainable, it includes listings of all officials of villages, townships, cities, counties, and states of the area. Included are listings covering the states of Ohio, Michigan, Indiana, Kentucky, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North and South Dakota.

Electrochemical Constants

National Bureau of Standards Circular 524 Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 310 pp., $2

THIS Circular embodies the proceedings of the NBS Semicentennial Symposium on Electrochemical Constants held at the National Bureau of Standards on September 19-21, 1951.

A knowledge of standards of electromotive force, resistance, and current are of importance in all fields of electrochemistry. A knowledge of other electrochemical constants, including equivalent conductances, transference numbers, ionization constants, activity coefficients, electrode potentials, and the parameters of electrode kinetics, polarography and electrophoresis, is of importance in studies of electrochemical equilibria and mechanisms.

The papers in this volume present some of the latest developments, both experimental and theoretical, in the field of fundamental electrochemistry from many leading establishments in the United States and abroad.

There are 30 contributions from men considered as experts in their respective fields. The majority of the papers are accompanied by extensive lists of references and pertinent discussions.

• • •

Electrodeposition Research

National Bureau of Standards Circular 529, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 130 pp., $1.50

THIS book contains the papers and discussions presented at the Semicentennial Symposium on Electrodeposition Research held at the National Bureau of Standards in December, 1951.

Electrodeposition processes have become an integral and important part of many industries—for example, the printing, metal refining, extractive metallurgy, hardware, automobile, and electronic industries. This has come about largely as a result of extensive research in the field of electrodeposition, especially during the past 25 years.

To encourage further research in this field, to present current research results and problems, and to facilitate the exchange of information, the National Bureau of Standards held the Symposium on Electrodeposition Research as the last of a series of twelve symposia conducted during the Bureau's semicentennial in 1951. The papers presented at the Symposium represent a cross-section of research currently being conducted in electrodeposition by industrial, university, and government laboratories in Europe and the United States.

The Symposium was planned and conducted by the Bureau's Electrodeposition Section, particularly by William Blum, Chief of the Electrodeposition Section until his retirement on December 31, 1951, and well-known supporter of ASTM.

• • •

A Study of Some Factors Affecting the Tear and Water Resistance of Light-weight Clothing and Tentage Fabrics

Textile Series Report No. 81, 1953, 24 pp., with tables and charts, Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C., 75¢

IN THE search for a new light-weight cotton fabric of high wind, water, and tear resistance, 16 sateen and water-resistant twill fabrics were tested for tear and water resistance, dynamic absorption, air permeability, and spray and drop penetration. The results indicate that 5.8 oz. high sley 5-harness sateen fabrics, of combed, plied, and mercerized yarns, have higher tear resistance than wind-resistant twill fabrics and can be satisfactorily used as replacements.

• • •

Handbook of Asbestos Textiles

Asbestos Textile Inst., Myril C. Shaw, Secretary, Rutgers University, New Brunswick, N. J., 84 pp., $1.

THIS handbook is intended primarily as a source of information about asbestos textiles. Divided roughly into three parts, it discusses (1) the origin and major properties of the mineral, and the mining, milling, and processing procedure for conversion to textiles; (2) the various products and their applications, properties, and representative uses; (3) a section giving the ASTM specifications and methods of test for asbestos textiles, and a glossary of terms.

It is amply illustrated, printed in large, clear type, and written in a style that can be readily understood by the nontechnical reader.

• • •

Corrosion

Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y., $1.75

THIS series of eight papers reprinted from "Research," Vol. 5, 1952, covers a number of time-worn subjects including prevention of corrosion by metallic coatings, protective action of paints, prevention of corrosion by means of inhibitors and by means of cathodic protection, the general subject of corrosion testing, and the general principles of corrosion.

Although much of the material presented here is already well known to the corrosion engineer, it would undoubtedly be of value to an engineer just entering the corrosion field, embodying as it does many of the fundamentals concerned with the prevention and the use of corrosion testing methods.

ASTM Director Speaks on Rubber and Plastic Cable

A HISTORY of the development and growth in the use of rubber and plastic compounds was given along with the appraisal of the various types of insulating materials presently available, in a paper recently presented by R. A. Schatzel, Vice-President and Director of Engineering, Rome Cable Corp., at the second Annual Meeting of the Non-Ferrous Division of the Wire Assn., in Waterbury, Conn. Some interesting production figures of broad interest were given and of special interest to those in our own Committee D-11 on Rubber and Rubber-Like Materials, who have done yeoman work in the field of wire and wire products.

Mr. Schatzel, a Director of ASTM, and for many years an active committee officer and worker, noted in his paper that the largest single type of polymer used in the wire industry is rubber, natural and synthetic. The wire industry consumes approximately 4 per cent of the total rubber produced in the United States, and tires about 70 per cent. This proportion is not likely to change greatly. Because the wire industry depends on these materials as dielectrics and for mechanical protection it has exacting additional requirements in the polymers it uses which are not encountered in any other application of rubber or plastics.

Mr. Schatzel said further that it is as important as ever that the wire industry representing this 4 per cent of the market should be alert and should present sound technical guidance to the producer of both natural and synthetic rubber. Fortunately, through the medium of committees of the Insulated Power Cable Engineers, American Chemical Society, and ASTM, the industry has instruments for working with cooperative producers on a common meeting ground.

He emphasized the need to develop an industry conscience as represented by sound specifications, practices, and recommendations. This can be done by using and supporting industry organizations dedicated to that purpose.

Three Years' Outdoor Weather Aging of Plastics Under Various Climatological Conditions*†

By S. E. Yustein, R. R. Winans, and H. J. Stark

SYNOPSIS

The effects of outdoor weather aging under widely different climates are investigated for various types of plastic materials. Five climatological regions are represented in the program which provides for outdoor exposures on sites located in (1) Panama Canal Zone (tropical); (2) New Mexico (dry desert); (3) New York (temperate); (4) Fort Churchill, Canada (subarctic); and (5) Point Barrow, Alaska (arctic). The materials investigated include five types of clear transparent sheet plastics, six types of laminated materials, and five types of molded terminal bars. Various exposure periods from 1 to 36 months were employed, and various mechanical, electrical, and optical properties were evaluated. On the basis of the extensive data accumulated, it is possible to deduce the occurrence of a wide variety of effects that appear to be related to differences in the climatic and environmental conditions and in the exposure periods.

THE present increasing use of plastic materials in equipment essential for military operations in tropical and arctic areas as well as other regions has made necessary an increased study of the effects of various climates on these materials. To obtain data for use in the design of such equipment, an investigation was undertaken of the weathering action of several different climates on various transparent, laminated, and molded plastic materials. This investigation was part of a joint program by the Bureau of Ships, U. S. Navy, and Bureau of Ordnance, U. S. Army, and provided for outdoor exposures up to periods of 3 yr. An overall view of the Bureau of Ships' program is presented in Table I. The exposure stations selected, the materials investigated, and the tests and test methods employed were described in the April, 1951, issue of the ASTM BULLETIN. Some of the results obtained after the first and second years' exposure were discussed therein. The present paper summarizes the results obtained at the completion of the 3-yr program.

The weather data furnished by each of the exposure stations are presented graphically in Fig. 1 and summarized in Table II. In order to obtain quantitative indication of the sunshine factor, provision was made for measurements of solar radiation; for this purpose, "Eppley" pyrheliometers were installed and operated at the New York, Canada, and Alaska exposure sites. The data obtained from the daily records are included in the weather data curve sheet of Fig. 1.

Results:

Numerical data obtained at the conclusion of the first year's exposure were presented in the April, 1951, issue of the BULLETIN. For purposes of this report, it was not considered necessary to present the extensive numerical data accumulated over the entire 3-yr program. Instead, the results have been summarized by noting the occurrence of any significant changes in the various properties evaluated. In the case of the tension and flexural strength data, the control charts technique as outlined in the ASTM Manual of Quality Control of Materials[1] was employed to determine the occurrence of significant effects. In the case of the other properties evaluated, the occurrence of significant changes was estimated from an inspection of the tabulated data. The various changes thus determined have been summarized in Tables III through XIII. Where the changes observed were considered negligible or the data obtained were not considered sufficiently indicative of a significant change, no change is reported.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at the Fifty-sixth Annual Meeting of the Society, June 28 to July 3, 1952.

† The opinions or assertions contained herein are those of the authors and are not to be construed as reflecting the views of the Department of the Navy or the Naval Service at large.

[1] Issued as ASTM *STP No. 15-C* (1951).

TABLE I.—OUTLINE OF BUREAU OF SHIPS' OUTDOOR WEATHER AGING PROGRAM.

Group	Materials	Properties Evaluated	Exposure Stations	Exposure Periods, months
Transparent plastic materials...	1. Methyl methacrylate 2. Cellulose acetate 3. Allyl resin 4. Vinyl copolymer 5. Cast phenolic	1. Tensile strength 2. Tensile modulus 3. Flexural strength 4. Hardness 5. Dielectric constant 6. Power factor 7. Light transmission 8. Haze	1. Panama 2. New Mexico 3. New York 4. Canada 5. Alaska	Panama and New Mexico: 1, 3, 7, 12, 18, 24, 30 New York, Canada, and Alaska: 3, 7, 12, 18, 24, 30, 36 Shelf: 36
Low-pressure plastic laminates..	6. Styrene maleate polyester, glass base 7. Styrene phthalate polyester, glass base	1. Tensile strength 2. Tensile modulus 3. Flexural strength 4. Hardness 5. Dielectric constant 6. Power factor	Same	Same
Melamine, silicone, and phenolic laminates.....	8. Melamine formaldehyde, glass base (GMG) 9. Silicone, glass base (GSG) 10. Phenol formaldehyde, paper base (PBG) 11. Phenol formaldehyde, fabric base (FBG)			
Molded terminal blocks.....	12. Cellulose-filled phenolic (CFG) 13. Cotton-filled phenolic (CFI-20) 14. Mineral-filled phenolic (MFI-20) 15. Cellulose-filled melamine (CMI-5) 16. Glass-filled melamine 17. Glass-filled silicone	1. Insulation resistance 2. Dielectric breakdown 3. HI shock resistance	Same	All stations: 6, 12, 24 Shelf: 24

Photographs of sections of specimens before and after weather aging are presented for the cellulose acetate, vinyl copolymer, and cast phenolic materials (Figs. 7, 8, and 9). The light transmission and haze data obtained for all five transparent materials are presented graphically on Figs. 2 through 6.

Sheet Materials

Effects of Outdoor Weather Aging on Materials Investigated:

On the basis of the changes summarized in Tables III through XIII, some generalizations regarding the effects produced by the different exposures on each of the materials investigated may be noted. These are summarized briefly as follows:

(*a*) *Methyl Methacrylate.*—The most pronounced effects were produced by the Panama and, possibly, the New York exposures. On the whole, however, the serviceability of the material could not be said to have suffered any serious impairment as the result of any of the exposures. In appearance, the exposed samples after being washed were, for the most part, indistinguishable from the unexposed samples.

(*b*) *Cellulose Acetate.*—The deterioration in surface and mechanical strength

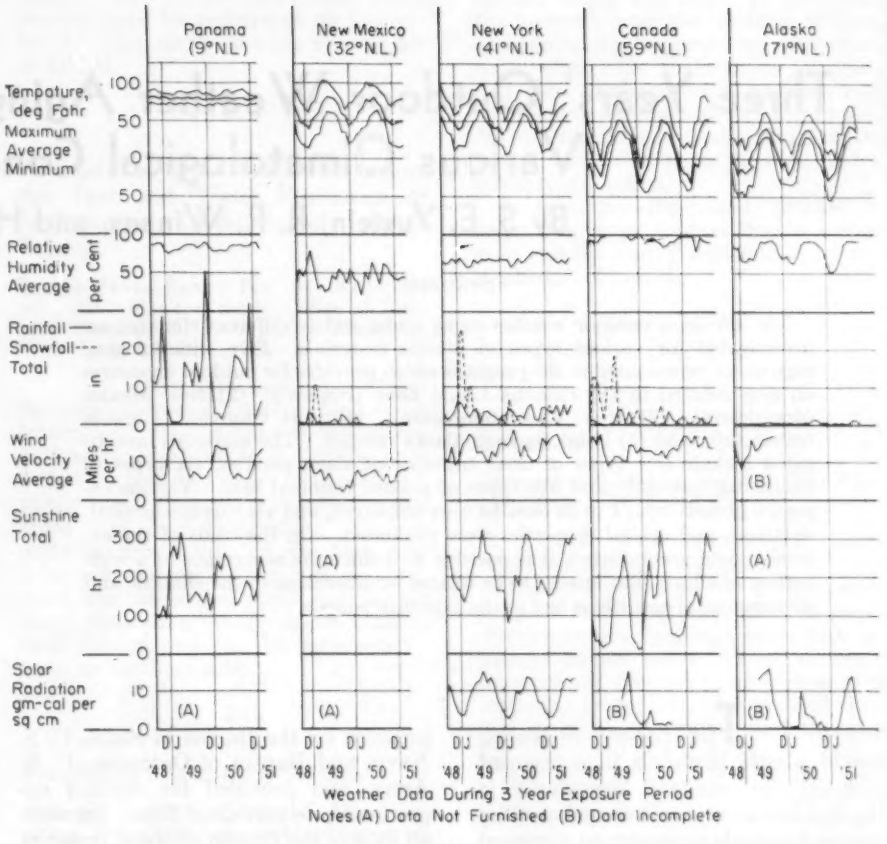


Fig. 1.—Weather Data During 3-yr Exposure Period.

TABLE II.—SUMMARY OF CLIMATOLOGICAL AND METEOROLOGICAL CONDITIONS AT EXPOSURE SITES EMPLOYED IN OUTDOOR WEATHER AGING PROGRAM ON PLASTIC MATERIALS.

Station	Panama	New Mexico	New York	Canada	Alaska
North latitude	9°	32°	41°	59°	71°
Climate	Tropical	Desert Semi-arid	Temperate Classed as "warm, humid climate of the middle latitudes"	Sub-arctic Classed as "cold, humid climate of the middle latitudes"	Arctic or tundra
Temperature	Uniformly high throughout the year, ranging from 70 to 90 F	High temperatures with marked diurnal ranges in which differences as great as 50 F frequently occur	Large annual range; climate characterized by extreme weather changes and strongly contrasting seasons	Large annual range; warm season of 5 months with temperatures ranging from 10 to 80 F alternates with a cold season of 7 months with temperatures ranging from −40 to 40 F	Extremely cold, with large annual range; warm season of 4 months (20 to 60 F) alternates with cold season (−50 to 35 F)
Precipitation	A "dry" season of 4 months alternates with a rainy season of 8 months	Comparatively little rain, clouds, or fogs; few general storms	Moderate rainfall and snowfall	Heavy snowfall; occasional occurrence of ice fogs, snow fogs, and falling ice crystals	Snowfalls to depth of perhaps 4 ft or so and packed by high winds into solid drifts; yet total precipitation is small
Humidity	Uniformly high, averaging 75 to 90 per cent	Exceedingly dry with abrupt changes	Rapid irregular changes	High	High
Winds	Strong winds during "dry" season alternating with gentle winds during rainy season	Moderate to gentle winds	Gentle to strong winds	Moderate to strong winds	Moderate to very strong winds
Sunshine	Intense sunshine producing strong ultraviolet radiation	Abundant intense sunshine producing very strong ultraviolet radiation	Moderate	Moderate, but somewhat less than for the New York exposure	Comparatively little sunshine over the year
Local factors	.....	.....	Exposure station located in an industrial and manufacturing center; as a consequence, atmospheric conditions at this exposure site are characterized by severe contamination with smoke, dust, industrial gases	Exposure station located at an inland site	Exposure station located close to Arctic Ocean. Prevalence of freezing temperatures combined with the salt atmosphere provided by the Arctic Ocean may represent environmental factors accelerating deterioration in some materials
Initial exposures	One and 3-month specimens exposed in rainy season	Specimens exposed to fairly uniform conditions throughout the year	Three-month specimens exposed through part of summer and part of fall	Three-month specimens exposed through part of summer and part of winter	Three and 7-month specimens exposed through winter with temperatures falling as low as −50 F and remaining below 0 F

produced by the New York exposures represented by far the worst deterioration in any of the materials or exposures investigated. Panama was next in severity of effects, producing marked deterioration after practically all exposures. Alaska exposures of 18 months or more duration also produced deterioration in the material. The New Mexico and Canada exposures produced comparatively minor effects.

(*c*) *Allyl Resin.*—The Panama and Alaska exposures produced the most pronounced effect noted but, on the whole, notwithstanding the occasional reductions in mechanical strength values, the serviceability was not appreciably affected.

(*d*) *Vinyl Copolymer.*—The most pronounced effects were produced by the Panama and New Mexico exposures of 7 months or more. These effects consisted chiefly of a darkening in color which became more marked with further exposures until the specimens were completely opaque. Exposures at the other stations also produced discolora-

TABLE III.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON METHYL METHACRYLATE.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength.....	Decreased with period of exposure	Decreased after 18 months and 30 months. Variability in data increased with prolonged exposure	Decreased after most exposures; variability in data increased with prolonged exposure	Appeared to show cyclical behavior	Appeared to show cyclical behavior, but with less extremes than Canada	Increased
Flexural strength.....	Decreased with period of exposure	.....	Highly erratic effects in which average results showed no significant changes but individual data showed great variability	Decreased with period of exposure	Decreased slightly after prolonged exposure	.....
Light transmission.....	Decreased slightly	.....	Decreased slightly	.....	.....	.....
Haze.....	Increased slightly	Increased slightly	Increased to 6 per cent	Increased slightly	Increased slightly	Increased slightly
Surface and appearance..	Yellowed slightly after 12 months	Yellowed slightly after 12 months	.....	.....	.....	.....

TABLE IV.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON CELLULOSE ACETATE.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength.....	Decreased with period of exposure	Same as for Panama	Decreased with period of exposure	Decreased slightly	Decreased slightly.	Decreased slightly
Flexural strength.....	Decreased after 24 months with increased variability of data	Same as for Panama	Decreased with period of exposure	.....	.....	.....
Tensile modulus.....	Changed erratically	.....	.....	.....	.....	.....
Rockwell hardness.....	Changed erratically at all stations					
Light transmission.....	Decreased after 24 months; value after 30 months: 64 per cent	.....	Decreased rapidly after 7 months; value after 36 months: 10 per cent	.....	Decreased with period of exposure after 18 months; value after 36 months: 72 per cent	Decreased; value after 36 months: 82 per cent
Haze.....	Increased with exposure period to 44 per cent	Increased with exposure period to 6 per cent	Increased rapidly with exposure period to more than 90 per cent	Increased to 16 per cent after 36 months	Increased with exposure period to 36 per cent	Increased slightly to 3 per cent
Surface and appearance.	Warped after all exposures; crazed after 18 months	.....	Warped, crazed, and dirt-scarred; surface deteriorated rapidly with exposure period	.....	Crazed and clouded after 18 months	.....

TABLE V.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON ALLYL RESIN.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength.....	Decreased with exposure period ater 18 months	Increased after exposure of 24 months or more	.....	.....	.....	Increased
Flexural strength.....	Decreased considerably with exposure period	.....	Decreased after 36 months	Decreased after 18 months with increased variability in data	Decreased after most exposures	.....
Light transmission.....	Decreased very slightly after 30 months	Decreased very slightly after 30 months	Decreased to 80 per cent after 36 months	.....	.....	.....
Haze.....	Increased very slightly	Increased slightly	Increased to 7 per cent after 30 to 36 months	.....	Increased to 4 per cent after 36 months	.....
Surface and appearance..	Yellowed slightly	Yellowed slightly	Yellowed slightly	Yellowed slightly	Some areas in surfaces of samples exposed for 18 months or more showed deterioration	.....

tion which increased with exposure period, but the discoloration occurred to a lesser degree, and the further north the exposure, the less the extent of discoloration. Other effects noted were small decreases in the tensile and flexural strength values after most exposures, and cyclical changes in tensile strength values after exposures in Canada and Alaska. It is seen, from an inspection of the samples as shown in Fig. 8, that the serviceability of the material in applications requiring clarity depends chiefly on the type of exposure.

(*e*) *Cast Phenolic.*—The cast phenolic material like the cellulose acetate showed pronounced differences in the effects produced by the different exposure conditions. The Panama specimens showed marked discoloration, severe deterioration of surface and mechanical strength properties, and increased dielectric constant and power factor values. The New Mexico specimens also showed severe deterioration of mechanical strength properties but, in contrast, showed milder discoloration, unaffected surfaces, and improved dielectric constant and power factor properties. The New York specimens were characterized by other effects, much severer in character and extent, that seriously affected the mechanical strength values, light transmission, haze, color, and surface characteristics. The appearance of these specimens afforded evidence that the atmospheric contamination noted for the New York exposure site contributed considerably to the deterioration. The Canada specimens showed comparatively lesser changes on all scores. The Alaska specimens also showed lesser changes but, after 18 months' exposure, surface deterioration effects were noted; these effects, which included crazing and pitting, reduced the light transmission and increased the haze appreciably. On the whole, the material appears to have shown poor resistance to most of the outdoor exposures employed, particularly under the exposure conditions represented by the New York and the Panama exposure sites.

(*f*) *Styrene Maleate Polyester Glass-Base Laminate.*—Tensile strength values showed decreases generally after exposures of 7 to 12 months; the greater decreases occurred after 24 months for those exposed at the three lower stations (Panama, New Mexico, and New York) and after 30 months for those exposed at the two upper stations (Canada and Alaska). Flexural strengths of the Panama, Canada, and Alaska speci-

TABLE VI.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON VINYL COPOLYMER.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength	Decreased with exposure period	Decreased with exposure period	Decreased after 7 months, recovered and increased with further exposure	Appeared to show cyclical changes	Appeared to show cyclical changes, but with smaller extremes than for Canada	Increased
Flexural strength	Decreased slightly after some exposure	Decreased slightly after some exposure	Decreased after 30 months	Decreased slightly after some exposure	Decreased slightly after 24 months	.....
Light transmission	Decreased rapidly after 7 months, dropped to 6 per cent after 24 months	Decreased rapidly after 7 months, dropped to about 1 per cent after 12 months	Decreased after 18 months, dropped to 22 per cent after 36 months	Decreased after 24 months, dropped to 30 per cent after 36 months	Decreased slightly after prolonged exposure	
Haze	Increased rapidly until value was too great to be of any significance (24 months)	Increased rapidly until value was too great to be of significance (12 months)	Increased with period of exposure to more than 25 per cent	Increased with period of exposure to about 7 per cent	Increased to about 3 to 4 per cent after 36 months	Increased to 4 per cent
Surface and appearance	Specimens exposed 7 months showed appreciable darkening which increased with exposure period until specimen became opaque (30 months)	Specimens exposed 7 months showed appreciable darkening which increased with exposure period until specimen became almost completely opaque (12 months)	Specimens exposed 12 months showed darkening which increased with exposure period	Specimens exposed 18 months showed darkening which increased with exposure period	Specimens exposed 24 months showed darkening which increased with exposure period	....

TABLE VII.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON CAST PHENOLIC.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength	Decreased considerably after all exposures			Decreased after all exposures		Increased
Flexural strength	Decreased with period of exposure to less than ½ of its original value	Decreased with period of exposure to less than ⅔ of its original value	Decreased with period of exposure to less than ½ of its original value	Decreased with exposure period but partially recovered after prolonged exposure	Decreased with exposure period but partially recovered after prolonged exposure	Decreased
Tensile modulus	Changed erratically	Increased	Changed erratically	.....	.....	.....
Hardness	Decreased	Increased after 12 months	Decreased	Decreased	Decreased	Decreased
Dielectric constant and power factors	Increased	Decreased	Decreased	.....	.....	Decreased
Light transmission	Decreased with exposure period to 59 per cent after 30 months	Decreased slightly after 30 months	Decreased with exposure period to 29 per cent after 30 months	.....	Decreased slightly after 12 months	.....
Haze	Increased with exposure period to more than 50 per cent	Increased with exposure period to 29 per cent	Increased rapidly with exposure period to over 80 per cent	Increased to about 4 to 8 per cent	Increased to about 4 to 18 per cent	.....
Surface and appearance	Discolored to a brownish yellow which darkened with continued exposure; warped and crazed after most exposures	Discolored to a light brownish yellow after all exposures	Discolored and crazed; deterioration increased with continued exposure	Discolored to a light brownish yellow after all exposures	Discolored to a light brownish yellow which darkened slightly with continued exposure; crazing and pitting after 18 months	.....

TABLE VIII.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON STYRENE MALEATE POLYESTER GLASS-BASE LAMINATE.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength	Decreased with period of exposure after 3 to 7 months					Increased slightly
Flexural strength	Decreased with period of exposure after 3 to 7 months			Decreased with period of exposure to a considerably greater extent than for the other exposures		Increased slightly
Dielectric constant	60-cycle and 1-kc values increased after all exposures, but the magnitudes of the increases diminished with exposure period	60-cycle and 1-kc values increased after all exposures up to 24 months; increases diminished with further exposure	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values increased after all exposures and to a greater extent than for all the other exposures	Decreased
Power factor	Increased after most exposures, but the magnitudes of the increases diminished with exposure period	60-cycle and 1-kc values generally showed increases but of smaller magnitudes than for the other exposures	Increased after all exposures	Increased after all exposures	Increased after all exposures and to a greater extent than for the other exposures	Decreased
Hardness	Decreased after most exposures					

TABLE IX.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON STYRENE PHTHALATE POLYESTER GLASS-BASE LAMINATE.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength	Decreased with period of exposure	Decreased after some exposures	Decreased after most exposures	Decreased with period of exposure	Decreased with period of exposure	.....
Flexural strength	Decreased with period of exposure	.....	Decreased slightly	Decreased with period of exposure	Decreased with period of exposure	.....
Dielectric constant	60-cycle and 1-kc values increased after all exposures, but the magnitudes of the increases diminished with exposure period	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values showed considerable increases; 1-mc values showed slight increases	60-cycle and 1-kc values showed considerable increases; 1-mc values showed slight increases	.....
Power factor	Increased after all exposures	60-cycle and 1-kc values increased after all exposures	Increased after all exposures	Increased considerably after all exposures	Increased considerably after all exposures	.....
Hardness	Decreased after most exposures					

TABLE X.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON MELAMINE FORMALDEHYDE GLASS-BASE LAMINATE.

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength	Increased after initial exposures, then dropped to approximately the original values with further exposures			Increased with period of exposure	Increased with initial period of exposure, then leveled off	.....
Flexural strength	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased
Dielectric constant	Increased slightly after all exposures	Decreased slightly	60-cycle and 1-kc values increased slightly after all exposures	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values increased after all exposures; the increases after 18 months were sharp	Decreased
Power factor	Increased after all exposures	60-cycle and 1-kc values generally showed decreases	Increased after all exposures	Increased after all exposures	Increased after all exposures, some showing sharp increases	60-cycle and 1-kc values decreased
Hardness	Decreased after all exposures					

TABLE XI.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON SILICONE GLASS LAMINATE (GSG).

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength	Significant decrease shown only by 12-month samples	Decreased after exposures of 3 months or more	Significant decrease shown only by 7-month samples	Significant decrease shown only by 7-month samples	Significant decrease shown only by 30-month samples	.....
Flexural strength	Decreased after all exposures	.....	Decreased after all exposures	Decreased after most exposures	Decreased with period of exposure	.....
Rockwell hardness	Increased after most exposures					Increased
Dielectric constant	60-cycle and 1-kc values increased slightly	.....	.....	60-cycle and 1-kc values increased appreciably after all exposures	60-cycle and 1-kc values increased after all exposures, very sharply after some exposures	Decreased
Power factor	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values increased after most exposures and to a generally smaller extent	60-cycle and 1-kc values increased after all exposures	Increased appreciably after all exposures	60-cycle and 1-kc values increased considerably and with extraordinary sharpness; the 1-mc values also increased, but irregularly	Decreased

mens decreased with period of exposure; flexural strengths of the New Mexico and New York specimens increased after the initial exposures but decreased with exposure period thereafter. The dielectric constant and power factor properties deteriorated after all exposures, but the Canada and Alaska specimens appeared to show the greatest deterioration.

(*g*) *Styrene Phthalate Polyester Glass-Base Laminate.*—The material showed small decreases in tensile and flexural strength after most exposures. Dielectric constant and power factor 60-cycle and 1-kc properties showed deteriorations after exposures at all stations; the greatest deterioration occurred for the Canada and Alaska exposures, which also appeared to produce deteriorations in the 1-mc properties. A comparison of the effects produced in both low-pressure polyester glass-base laminates by the various exposures may indicate some differences which would be of appreciable significance in considering the chemical and physical structures of the materials; in actuality, both materials appeared to show on the whole similar behavior, and the differences in effects produced by the different exposures on the two types of low-pressure polyester glass-base laminates do not appear to indicate the superiority of one over the other in respect to weather aging resistance.

(*h*) *Melamine Formaldehyde Glass-Base Laminate (GMG).*—Tensile strengths of this material unlike those of all other materials showed general increases after exposure at all stations.

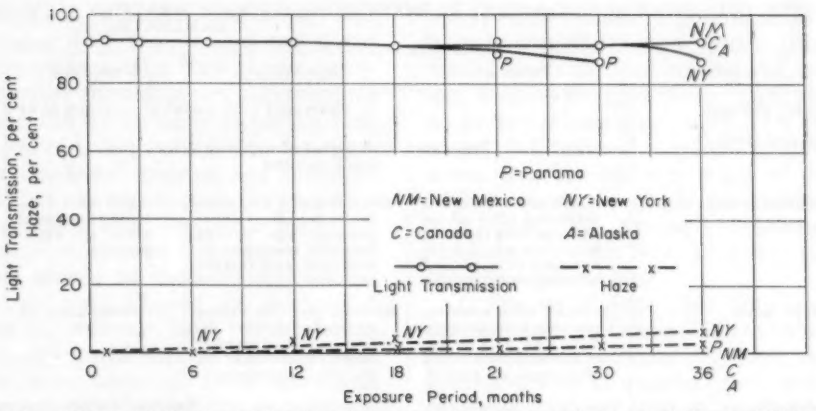


Fig. 2.—Effects of Outdoor Weather Aging on Light Transmission and Haze of Methyl Methacrylate.

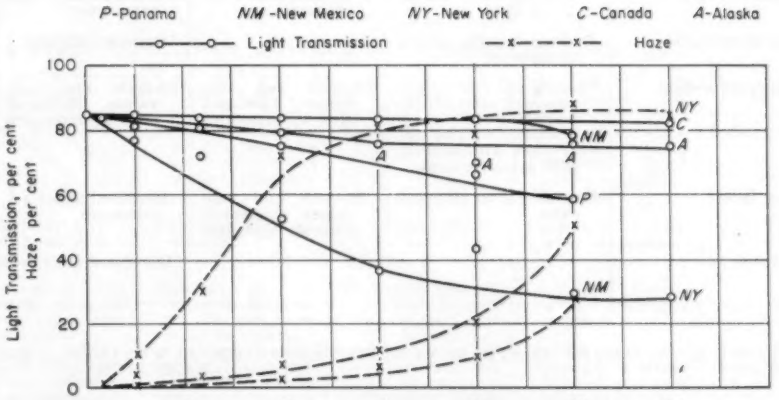


Fig. 3.—Effects of Outdoor Weather Aging on Light Transmission and Haze of Cast Phenolic.

TABLE XII.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON PHENOLIC PAPER-BASE LAMINATE (PBG).

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength.....	Decreased with period of exposure	Increased after 24 months and more	Decreased after 7 months	Significant decrease shown only by 3-month samples	Decreased after 12 months	.....
Flexural strength.....	Decreased slightly	.....	Decreased slightly	Decreased slightly	Decreased slightly	Decreased slightly
Dielectric constant.....	60-cycle and 1-kc values increased sharply, 1-mc values slightly	Decreased after some exposures	60-cycle and 1-kc values increased	Increased after all exposures	Increased after all exposures and to a greater extent than at all other exposures	60-cycle and 1-kc values increased
Power factor.....	60-cycle and 1-kc values increased sharply	Decreased after most exposures	60-cycle and 1-kc values increased after all exposures	60-cycle and 1-kc values increased sharply	60-cycle and 1-kc values increased sharply	.....

TABLE XIII.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON PHENOLIC FABRIC BASE LAMINATE (FBG).

Property	Panama	New Mexico	New York	Canada	Alaska	Shelf
Tensile strength.....	Decreased with period of exposure	.....	Decreased with period of exposure	.....	.....	.....
Flexural strength.....	Decreased after most exposures	.....	Decreased with period of exposure	.....	.....	.....
Dielectric constant....	60-cycle values increased after all exposures, 1-kc values after some exposures	Decreased after some exposures	60-cycle values increased after all exposures, 1-kc values increased after most exposures	60-cycle values increased after all exposures, 1-kc values increased after most exposures	60-cycle and 1-kc values increased after all exposures	.....
Power factor.....	Increased after some exposures, decreased after others	Decreased after all exposures	60-cycle values increased after all exposures, 1-kc values increased after most exposures	60-cycle values increased after all exposures, 1-kc values increased after most exposures	60-cycle and 1-kc values increased after all exposures	.....

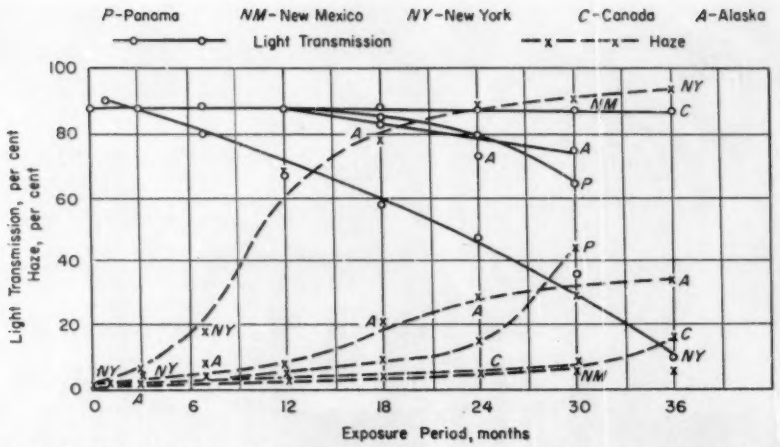


Fig. 4.—Effects of Outdoor Weather Aging on Light Transmission and Haze of Cellulose Acetate.

In the case of the specimens exposed at the lower stations (Panama, New Mexico, and New York), the tensile strengths returned after prolonged exposure to approximately the original values. The flexural strength values, on the other hand, appeared to show general decreases with period of exposure for all stations. The dielectric constant and power factor showed improvement after shelf aging and after exposures at New Mexico, but general deterioration after exposures at the other stations, particularly Canada and Alaska.

(*i*) *Silicone Glass-Base Laminate (GSG).*—Specimens showed occasional small decreases in tensile and flexural strength, and increased hardness values, after practically all exposures. The Canada and Alaska exposures produced marked deterioration in dielectric constant at 60 cycles and 1 kc and in power factor at all three frequencies. These increases were highly erratic and characterized by cyclical fluctuations.

(*j*) *Phenol Formaldehyde Paper-Base Laminate (PBG).*—Tensile and flexural strengths showed occasional decreases which were, on the whole, comparatively small. The 60-cycle and 1-kc values of dielectric constant and power factor values showed frequent improvement after exposures in New Mexico, slight deterioration after exposures in New York, and sharp deterioration after exposures in Panama, Canada, and Alaska. The latter stations also produced slight deterioration in the power factor at 1 mc.

(*k*) *Phenol Formaldehyde Fabric-Base Laminate (FBG).*—Tensile strength decreased after exposures at Panama and New York, and flexural strength decreased after exposures at all stations; in general, all decreases were comparatively small or slight. The dielectric constant and power factor values showed general decreases after shelf aging and after exposures in New Mexico but showed rather irregular increases after exposures at the other stations.

The following are several general effects that were noted in connection with some of the properties evaluated:

(*a*) *Tensile Strength.*—The Panama and New York exposures produced, on the whole, more decreases than the other exposures.

(*b*) *Flexural Strength.*—On the whole, the New Mexico exposures produced the fewest and smallest decreases.

(*c*) *Tensile Modulus and Hardness.*—Changes were slight or irregular and, in general, no particularly marked trend could be ascertained.

(*d*) *Dielectric Constant and Power Factor.*—The New Mexico exposures generally produced slight or negligible changes and in some cases produced improvement. The Canada and Alaska exposures produced the greatest deterioration in the glass-base laminate, whereas the exposures at all four "wet humid" stations produced about the same deterioration in the phenolic laminates.

(*e*) *Light Transmission, Haze, Color, and Surface Conditions.*—Differences in effects produced by the different exposures are evident from an inspection of the photographs (Figs. 7, 8, and 9). Surface deterioration and discoloration, where these occurred, were generally progressive and appeared to be related chiefly to solar radiation and, in a few cases, to some environmental factors such as atmospheric contamination.

Effects arising from differences in periods of exposure varied with the material and with the station. Most of the changes were of the deteriorative type, but not all changes were characterized by progressive deterioration. Changes, in which the effects were characterized by improvement, recovery, or "cycling," were noted in some cases.

Climatic and Environmental Factors Affecting Weather Aging:

The weather information gathered during the course of the investigation was selected to provide a comprehensive picture of the changes and differences occurring in those climatic factors that are considered to be of chief consequence in contributing to deterioration of the plastic materials. In most cases it is extremely difficult, if not impossible, to isolate any single climatic factor and assess the extent and nature of its contribution to the changes occurring in the evaluated properties. In a few cases, local environmental conditions appeared to be of greater consequence in producing deterioration than any of the climatic factors noted. The following paragraphs present a brief review of the more notable effects that may to a large extent be associated with some of the climatic or environmental factors prevailing at the exposure stations.

(*a*) For the cast phenolic and the laminated materials, the abundance or lack of moisture appeared to be a significant factor affecting the electrical

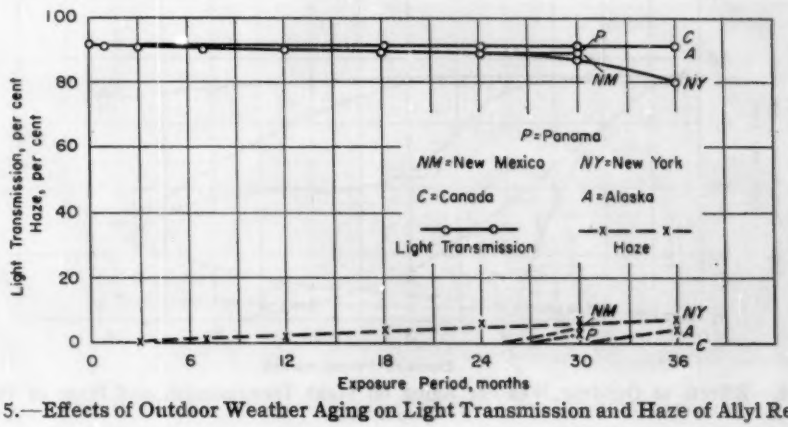


Fig. 5.—Effects of Outdoor Weather Aging on Light Transmission and Haze of Allyl Resin.

properties. The New Mexico specimens, for example, showed the smallest effects and, in some cases, even showed improvements. On the other hand, the conditions provided by the Canada and Alaska exposures, which represent cold, humid conditions, appear to be of still greater importance in affecting the electrical properties than the conditions provided by the warmer, humid exposures at Panama and New York.

(*b*) Differences in intensity and abundance of sunshine appeared to produce several notable effects. The New Mexico exposure with its year-round comparatively warm, arid climate may be considered to be characterized by the most abundant and intense solar radiation of all five stations. The ultraviolet radiation in this region would be strongest. Panama, with its tropical conditions, may be considered a close second. The abundance and intensity of radiation incident on the exposed materials then decreases the farther north the exposure. The photochemical changes produced in the vinyl copolymer material and resulting in the various discoloration effects noted represent the effects of these differences. The methyl methacrylate specimens showed slight yellowing after prolonged exposures in Panama and New Mexico, an effect that may be due to the strong ultraviolet radiation in these regions. The GMG and GSG materials showed discoloration effects which on the whole varied with the exposure period and with the latitude. Other effects may possibly be attributed to differences in solar radiations, but the character and extent of these effects are difficult if not impossible to ascertain.

(*c*) Another factor to be considered in studying the various changes produced, is represented by local environmental conditions, a factor about which the weather data accumulated affords little or no information. At the exposure station in New York, the temperate climate which, under natural conditions would produce moderate deterioration in most materials, is conditioned by atmospheric contamination with dust, smoke, ashes, and industrial gases. For some materials, particularly the cellulose acetate and the phenolics, this atmospheric contamination appeared to be the chief factor in accelerating deterioration of surfaces and strength properties.

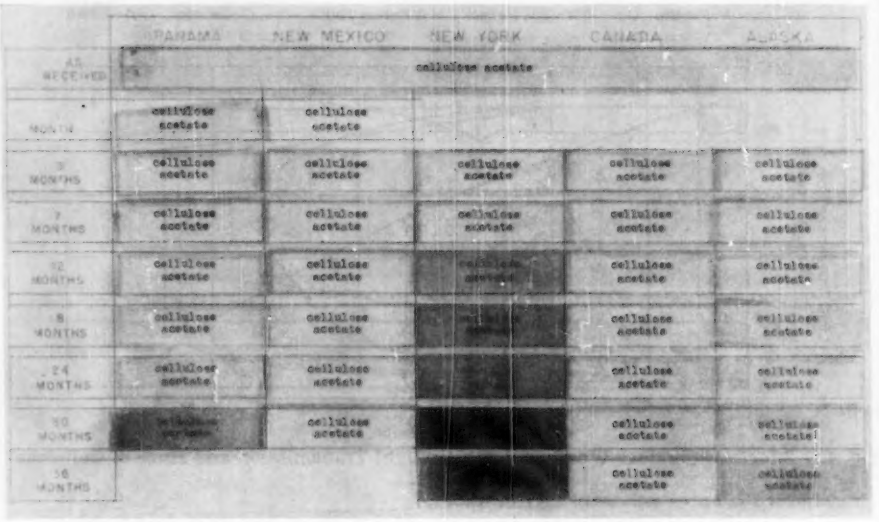


Fig. 7.—Effects Produced on Cellulose Acetate by Different Exposures.

(*d*) The surface deterioration effects produced in the cellulose acetate, allyl resin, and cast phenolic specimens exposed for long periods at Alaska appear to indicate that the exposure conditions at Point Barrow, Alaska, may be influenced by many complex factors peculiar to the climate and locality. A possible explanation may be sought by considering the effects in conjunction with the absence of similar or equal effects in the Canada specimens of these materials which are exposed at an inland site. One of the factors suggested by this comparison is the prevalence of freezing temperatures combined with nearness of the exposure site to the salt atmosphere conditions provided by the Arctic Ocean. It is possible that the effects observed may represent the action of the salt atmosphere on the particular materials affected, for the effects appear to be such as might occur if the materials were exposed to severe salt spray conditions for very prolonged periods.

(*e*) An interesting and curious result that should be noted is the contrast between the generally mild effects produced by both inland exposure sites (New Mexico and Canada) and the generally more severe effects produced by the three seacoast exposure sites (Panama, New York, and Alaska). It is believed that the differences produced are more than coincidental and indicate the operation of a complex factor in the climatic and environmental conditions producing deterioration in the plastic materials.

(*f*) It was noted above that the differences in exposure periods were provided because it was believed that the tropical climate at Panama and the hot, dry, desert climate at New Mexico represent more severe conditions than those at the other exposure sites. However, the data obtained in the course of this investigation afford evidence that the New Mexico conditions are comparatively mild in their effects on most of the materials. It also appears evident that, while the Panama exposures generally produced deterioration in most materials, the effects produced by the New York and Alaska exposures were, for some materials, equally or even more severe.

As a result of some of the problems experienced in the course of the in-

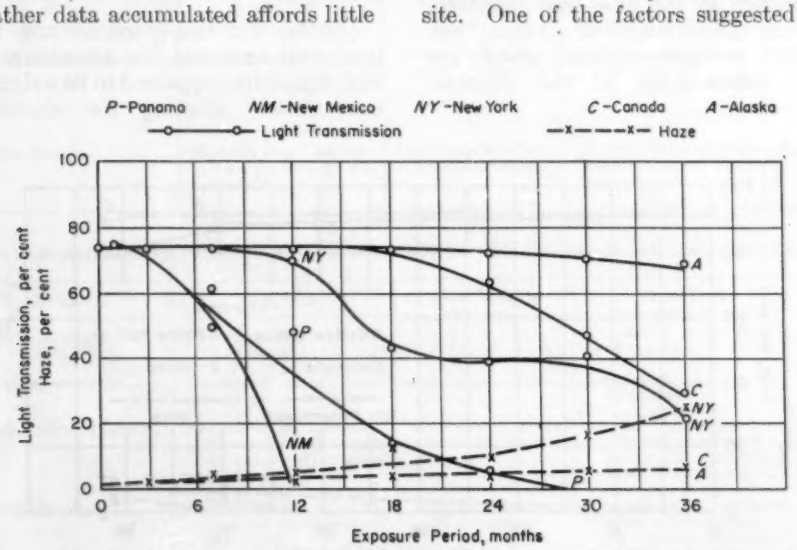


Fig. 6.—Effects of Outdoor Weather Aging on Light Transmission and Haze of Vinyl Copolymer.

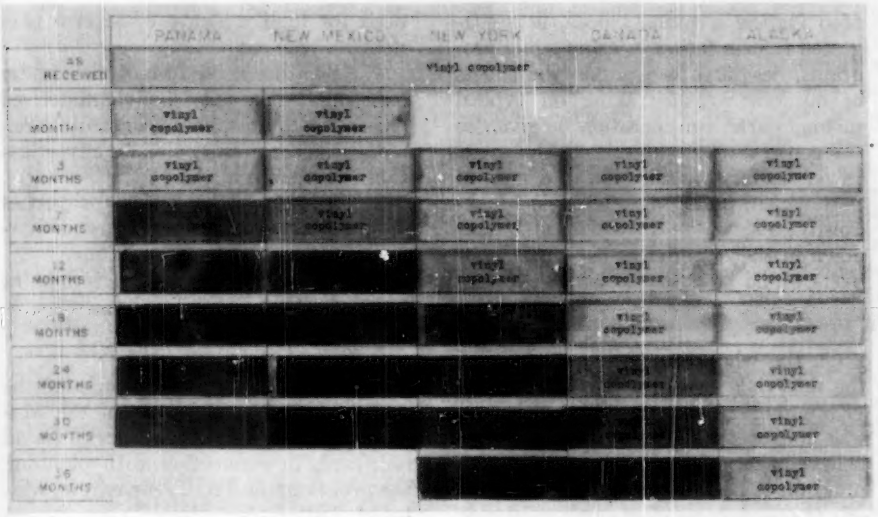


Fig. 8.—Effects Produced on Vinyl Copolymer by Different Exposures.

vestigation and on the basis of the various data obtained, several improvements in the program as originally set up suggest themselves, particularly in connection with selecting the properties to be evaluated. The following are the properties suggested for study:

1. Tensile strength, modulus, and elongation
2. Flexural strength and modulus
3. Rockwell hardness
4. Dielectric constant and power factor, 60 cycles, 1 kc, 1 mc
5. Dielectric strength, *S/T*
6. Light transmission and haze (transparent sheets)
7. Microscopic examination of surface

Tensile modulus and Rockwell hardness need not necessarily be included, as the data obtained in the course of this investigation indicated that the evaluations for these properties were of somewhat limited usefulness. Microscopic examinations are currently being made on specimens remaining from the tested samples; some of the materials appear to have undergone several unusual and interesting effects that are not visible to the naked eye. If it is desired solely to evaluate the resistance of a material to outdoor weather aging, then the above program can be reduced to provide for the following evaluations:

1. Flexural strength and modulus
2. Dielectric constant and power factor, 60 cycles, 1 kc, 1 mc
3. Dielectric strength, short time
4. Light transmission and haze (transparent sheets)
5. Microscopic examination

In connection with the above outlined programs, it is further suggested that the exposure specimens consist of five tensile strips (which are considered sufficient for evaluating tensile properties) and one panel 4 by 9 in. instead of the 2 by 8-in. strip previously used. The use of a 4 by 9-in. panel would make possible the preparation of two standard 4 by 4-in. specimens for the measurement of the electrical properties instead of a single nonstandard specimen previously employed. In addition, the use of the 4 by 9-in. panel would provide at least five flexural test specimens each 1 in. wide. In comparison with the $\frac{1}{2}$-in. wide specimens currently employed, a larger load would be required to produce the maximum flexural stress and, since five determinations could be made, more accurate data would be obtainable than the present data which are based on determinations made on three specimens each $\frac{1}{2}$ in. in width.

Molded Terminal Blocks

The following were the chief effects noted from a study of the data obtained in the evaluations conducted on the molded terminal blocks:

(*a*) *Phenolic Cellulose Filler* (*CFG*).—Insulation resistance decreased after all outdoor exposures except at New Mexico; it increased after shelf aging.

(*b*) *Phenolic Cotton Filler* (*CFI-20*).—Insulation resistance increased after all New Mexico exposures and shelf aging, but decreased after all other exposures. The high-impact shock resistance increased after most exposures including shelf aging.

(*c*) *Phenolic Mineral Filler* (*MFI-20*).—Insulation resistance increased after all New Mexico exposures and after shelf aging. The HI shock resistance increased after most exposures.

(*d*) *Melamine Cotton Filler* (*CMI-5*).—Insulation resistance decreased after all exposures except at New Mexico.

(*e*) *Melamine Glass Filler*.—Insulation resistance decreased after all exposures except at New Mexico.

(*f*) *Silicone Glass Filler*.—No significant changes were noted for the electrical properties evaluated. The HI shock resistance appeared to show some increase after the 24-month exposures at New Mexico and Canada. (24-month Panama samples have not been received.)

The general conclusions to be drawn from the weather aging program on the terminal blocks are as follows:

1. The New Mexico exposures produced increases in the insulation resistance for most of the materials, where

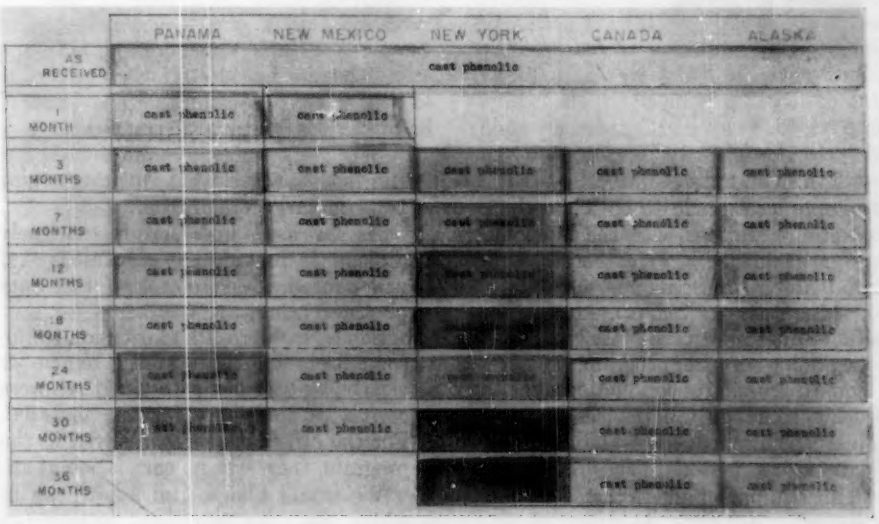


Fig. 9.—Effects Produced on Cast Phenolic by Different Exposures.

as exposures at the other stations generally produced decreases.

2. The high-voltage insulating properties of all the materials as measured by the dielectric breakdown did not appear to be appreciably affected by any of the exposures.

3. The CFI-20 and MFI-20 terminal blocks appear to have shown increases in the HI shock resistance as a result of the various exposures.

4. It is apparent that the 2-yr exposures at the various sites produced some changes in the properties evaluated, but these changes, on the whole, were not sufficient to affect seriously the serviceability of the specimens tested.

In view of the comparatively meager changes produced by the 2-yr weather aging program in the properties evaluated for the terminal blocks, it is suggested that in future weather aging programs, designed to evaluate the effects of outdoor weather aging on typical molded parts, consideration be given to the use of a more suitable molded part. In particular, the selection of a molded part which, under the dielectric breakdown tests, yields an electrical breakdown in the material rather than flashovers would be desirable.

Conclusions

On the whole the ability of most of the materials to withstand the 2 or 3-yr weather aging as well as they did was unexpected. In view of this, it is believed that a 5 to 10-yr weather aging program is necessary to evaluate properly the outdoor weather aging resistance of many plastic materials. The results of the investigation also indicate the need for further study of several phenomena such as:

1. Weather aging of materials under exposures that may be characterized chiefly by atmospheric contamination; a suggested exposure site for investigation is Pittsburgh, Pa.

2. Behavior of electrical properties of glass laminates under various low-temperature exposure conditions.

3. Weather aging of materials at seacoast sites and inland sites.

Acknowledgments:

The authors wish to acknowledge the assistance of D. H. Kallas of the Material Laboratory, New York Naval Shipyard, in connection with planning the program; and A. T. Stenstrom, Material Laboratory, New York Naval Shipyard, who performed the experimental work on the terminal blocks.

The Authors . . .

S. E. YUSTEIN was appointed to the Material Laboratory of the New York Naval Shipyard in 1941. As plastics technologist and materials engineer, he has been engaged in development work on test methods, test equipment, Government specifications and investigation programs on plastic materials.

R. R. WINANS, has been since 1943, head of the Section on Electrical Insulating Materials of the Material Laboratory, New York Naval Shipyard. For the past several years he has been involved mainly with Rigid Plastics and is in charge of all such work in the Material Laboratory.

H. J. STARK, formerly employed as a research and analytical chemist at the Naval Research Laboratory Plastics and Dielectrics Branch, Research and Development Division of the Bureau of Ships where he is Materials Engineer. He is a Registered Professional Engineer of the District of Columbia.

DISCUSSION

Mr. Charles Chaban[1]—What attempts were made to correlate the five exposure stations with the Fadeometer Weatherometer, Weathering Unit X-1-A, or RS Sunlamps?

Mr. Yustein (*author*).—I can answer that question very briefly. At the beginning of the program, there was some discussion of conducting some tests using some of the devices that were just mentioned. We have at the laboratory various types of weather aging equipment and in the past we have run some accelerated weather aging tests on various materials.

As far as I know, it is extremely difficult to provide any apparatus that will reproduce or correlate the data obtained in natural weather aging.

Some years ago, I had occasion to run some tests like that and I remember clearly we got some results that were correlated, but only for one material. For the other materials involved in the program, there was no correlation at all.

We would like to run a program in which we can correlate accelerated aging with the natural outdoor weather aging, but until some unit is developed that will reproduce the effects for all materials similarly we shall have to use the outdoor weather aging for our data.

Mr. Arman J. Kearfott.[2]—Did the glass-reinforced polyester laminates deteriorate to any extent on outdoor exposure?

Mr. Yustein.—There were two materials used in that program. One was a styrene maleate polyester, the other a styrene phthalate polyester and both were glass laminates.

[1] Chief Chemist, The Landers Corp., Toledo, Ohio.

[2] Engineer, General Motors Research, Detroit, Mich.

The results indicated that the mechanical strength showed some decreases at most of the stations, but the decreases were not such as to render the materials useless. On the other hand, the electrical properties were affected at practically all stations, particularly Panama, New York, Canada, and Alaska. As a matter of fact, both of them were affected to a greater extent electrically than the other materials.

MR. E. SCHWEIZER.[3]—I was very much interested in what Mr. Yustein said regarding the results of exposure in New York. He pointed out that the New York exposure is an exposure in an industrial atmosphere. I feel that if the exposure in the moderate zone would have taken place in a rural section, a smoother relationship between the results of tropical, subtropical, moderate, and Arctic exposures might have been found.

In our company, for instance, we conducted comparative exposure tests at our Newark, N. J., plant and at Madison, N. J. At the Newark plant we have an industrial atmosphere probably similar to the one prevailing in New York; the Madison station located about 17 miles from Newark is in a rural section of New Jersey. The results obtained at these two stations differed greatly in many cases. The exposed plastic samples, not only acetate, showed in general much more pitting and other signs of attack in Newark than they did at Madison.

I believe that this difference can be explained by the same mechanism which has been found to produce similar differences in exposed steel specimens. In an industrial atmosphere the corrosive gases and vapors are absorbed in the raindrops which fall on the exposed specimens. As the drops evaporate, the concentration of the corrosive agents in the drops increases and can finally become very high in the small area which the drop covers shortly before complete evaporation of the water. This concentration can be much higher than one would expect solely from the concentration of the corrosive gases in the air.

I would suggest that exposure tests be made at a location in the moderate zone where the air is not contaminated by industrial gases.

MR. YUSTEIN.—In connection with the use of the New York exposure station, it must be realized that the particular character of this exposure is not determined until after the test has been conducted. That was one of the purposes of the test, which was to determine the particular characteristics of the various exposures that were chosen.

We chose New York to represent a temperate climate. The fact that the data indicated that it might be a temperate climate modified by particular environmental factors represents very useful information. As a matter of fact, it might be very useful, not only to determine the effect of exposure in New York, but to make similar studies for other types of exposure stations such as, say, Pittsburgh, that might be similarly contaminated.

In answer to the question, there might be some additional data later on from another source. In conjunction with our program, there is a coordinated program being run by the U.S. Bureau of Ordinance in which a great group of materials are being exposed at Picatinny Arsenal. As far as I know it should be relatively free from contamination by most of the irritants contained in the New York area.

When the results are forthcoming, and I expect that they will be shortly, I am quite sure that the comparison of the results obtained for their area, which could be considered quite close to ours in latitude, and the results we obtained should be extremely interesting.

In the meantime, it is interesting to note that while the New York area was severe for some materials, it had no effect on other materials like methyl methacrylate, the melamine glass laminates, the allyl resins, and a few others, but it was severe on materials that age rapidly, materials like cellulose acetate, which may not resist weather aging at all, or materials like cast phenolic.

MR. ALBERT G. H. DIETZ.[4]—Did any of the glass-reinforced specimens have cut edges in which the glass fibers would be exposed and did they show any edge effects as a consequence?

MR. YUSTEIN: We made no tests to determine edge effects, if any; however, the exposure panel consisted of six tension test specimens already prepared and machined, and one 2 by 8.5-in. specimen to provide the electrical test sample.

As far as the edge tests are concerned, I cannot give you any information there. However, provision was made, in the case of materials which had directional properties, for the preparation of all samples in the direction of greatest strength.

MR. D. H. CARTOLANO.[5]—Has any work been done on determining the cumulative effect on these materials by cycling them over several exposure stations? It is very likely that some of these materials will experience more than one climatic condition, such as air transit materials and ship materials.

MR. YUSTEIN.—The exposures were all conducted in one location for a particular group of specimens. We had a panel for each exposure period, at each exposure station. We got the data for that particular station and that exposure.

MR. CARTOLANO.—It is all well and good for building materials but not for materials on moving installations, such as aircraft or ships.

MR. YUSTEIN.—That is true. We might have provided for other effects which would provide information along that line, but we were interested primarily in the effects produced by each of the exposures on certain particular properties.

What we did in this particular case was to start one of the first weather aging programs. The data secured would possibly provide information with regard to future weather aging programs. We were interested in what exposure stations could be selected, what type of aging programs should be used, what type of tests could be conducted, and what type of specimens could be prepared.

We realized that the tests, as conducted, probably had a great many limitations, but it did provide a great deal of information with regard to materials and with regard to each of the exposure stations.

MR. L. W. A. MEYER[6] (*by letter*).—This comment relates to the use of the cellulose acetate composition used in this testing program. The previous paper which appeared in the April, 1951, issue of the BULLETIN,[7] states that it consists of cellulose acetate with 20 per cent tricresyl phosphate and phthalate esters. As mentioned in the discussion by Mr. W. M. Gearhart, cellulose acetate compositions containing ultraviolet inhibitors (such as phenyl salicylate) are much more resistant to outdoor weathering than compositions such as here tested. It should also be mentioned that plastics of higher esters of cellulose (such as cellulose acetate butyrate) containing ultraviolet inhibitors have greatly improved outdoor weathering properties. Detailed comparisons are given in our paper on "Weather Resistance of Cellulose Ester Plastics."[8]

---

[3] Summit Research Laboratories, Celanese Corporation of America, Summit, N. J.

[4] Head, Course in Building Engineering and Construction, Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

[5] Naval Air Development Center, Johnsville, Pa.

[6] Superintendent, Tenite Development Department, Tennessee Eastman Co., Kingsport, Tenn.

[7] S. E. Yustein, R. R. Winans, and H. J. Stark, "Outdoor Weather Aging of Plastics Under Various Climatological Conditions," ASTM BULLETIN, No. 173, April, 1951, p. 31 (TP85). Discussion, p. 43 (TP97).

[8] *Industrial and Engineering Chemistry*, Vol. 37, March, 1945, p. 232.

Improved Scale System for Stiffness Testing Machine

By Harry LaTour and R. S. Sutton

Bend or stiffness tests requiring simultaneous readings of load and angle may be made more accurately and with less operator fatigue by mounting a rotatable inverse angle scale directly below the fixed load scale of machines of the Tour-Marshall design. A method of adapting this principle to Tinius Olsen stiffness testers of 6 and 50 in-lb capacities is illustrated and described.

STIFFNESS tests of the cantilever bending type have been incorporated in the ASTM test methods for wire,[1] plastics,[2] and strip and sheet metals for electronic devices.[3] A wide variety of other materials and special products are tested by means of stiffness testing equipment.

The Tinius Olsen Testing Machine Co. manufactures three stiffness testing machines employing the principles of the Tour-Marshal patents.[4] The application of an inverse scale measuring system to Tinius Olsen testing machines is described in the present paper. This inverse scale and other changes in the indicating system increase the utility of this instrument for research and production purposes.

Olsen Stiffness Testing Procedure for 6 in.-lb Tester:

The 6 in-lb moment capacity Olsen stiffness tester is shown in Figs. 1 to 3. Briefly, the six steps for conducting tests as listed by the manufacturer are:

1. Set the bending span by locking the plate which contacts the sample in the proper hole in the disk of the dynamometer.
2. Apply as much weight to the dynamometer as is necessary to bend the specimen to the required deflection. Adjust load scale to zero.
3. Clamp the specimen firmly in the vise.
4. Use the hand crank to bring the specimen against the bending plate. Set the deflection pointer to zero.
5. Hold down the motor engaging lever and record load and deflection readings at predetermined degrees of bending.
6. After making the specified bend,

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Method for Bend Testing of Wire (Wire for Radio Tubes and Incandescent Lamps) (B 113 – 41), 1952 Book of ASTM Standards, Part 2, p. 840.

[2] Method of Test for Stiffness in Flexure of Plastics (D 747 – 50), 1952 Book of ASTM Standards, Part 6, p. 647.

[3] Method of Test for Temper of Strip and Sheet Metals for Electronic Devices (Spring-Back Method) (B 155 – 50), 1952 Book of ASTM Standards, Part 2, p. 852.

[4] U S Patent Nos. 1,474,545 (Nov. 20, 1923) and 2,049,235 (July 28, 1936).

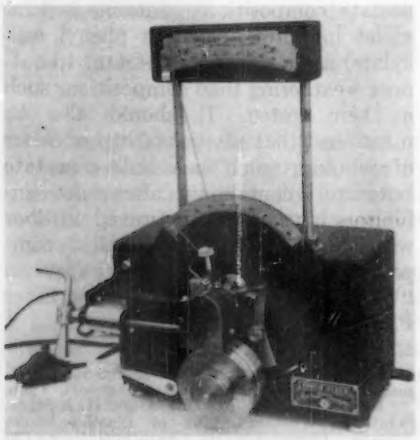
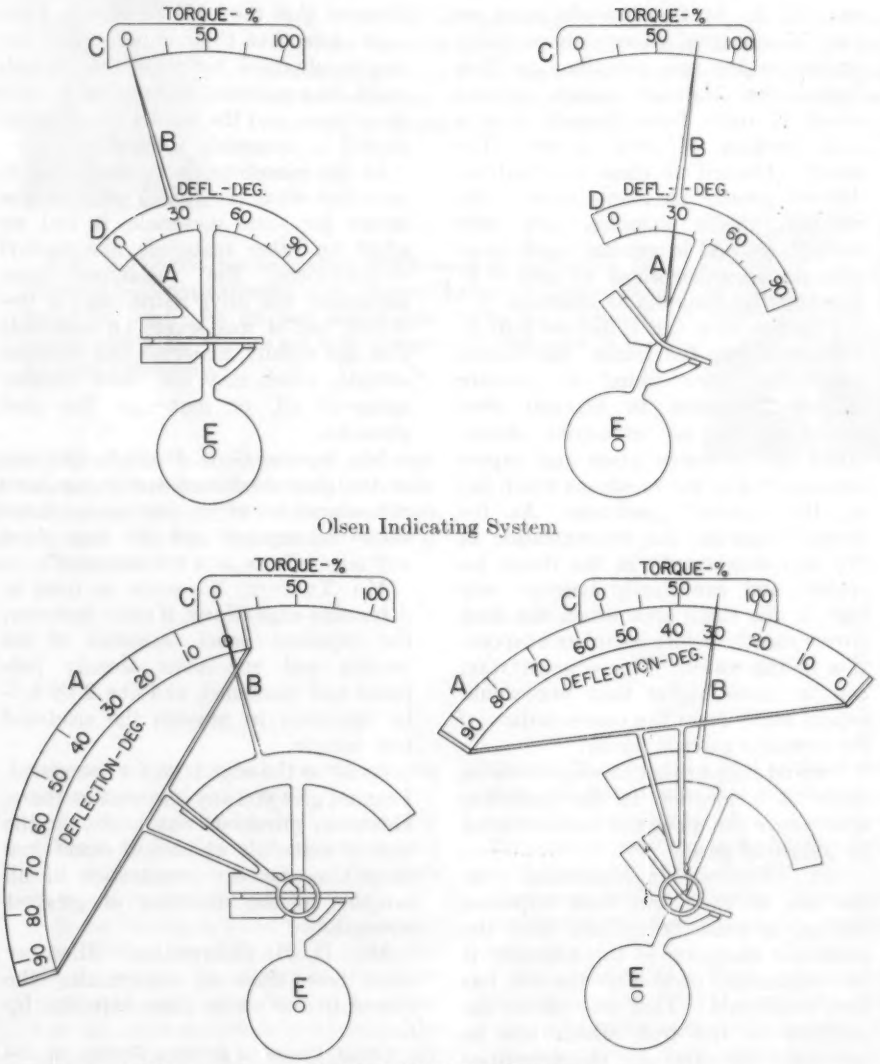


Fig. 1.—Stiffness Tester of 6 in-lb Capacity Made by the Tinius Olsen Testing Machine Co.



Olsen Indicating System

Modified Indicating System

Fig. 2.—Olsen Stiffness Tester of 6 in-lb Capacity with the Modified Inverse Scale System.

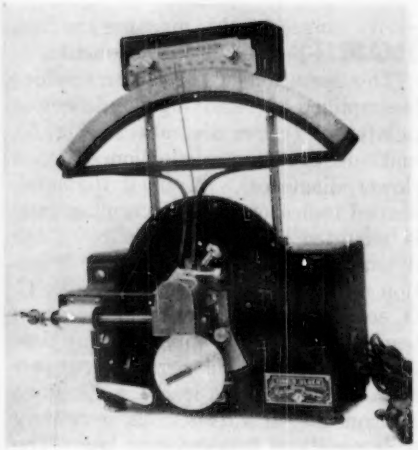


Fig. 3.—Diagrams Illustrating Modifications of the Indicating System of the 6 in-lb Capacity Olsen Stiffness Tester.

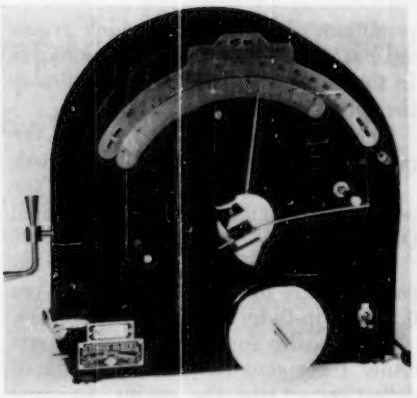


Fig. 4.—Stiffness Tester of 50 in-lb Capacity Made by the Tinius Olsen Testing Machine Co.

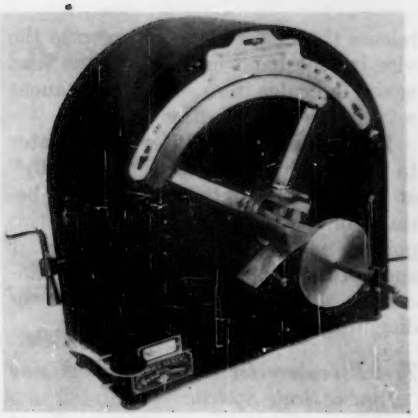
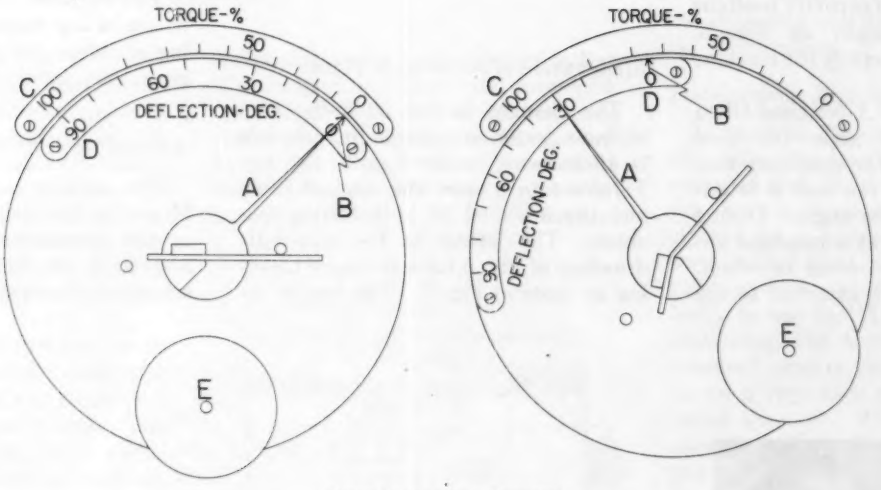
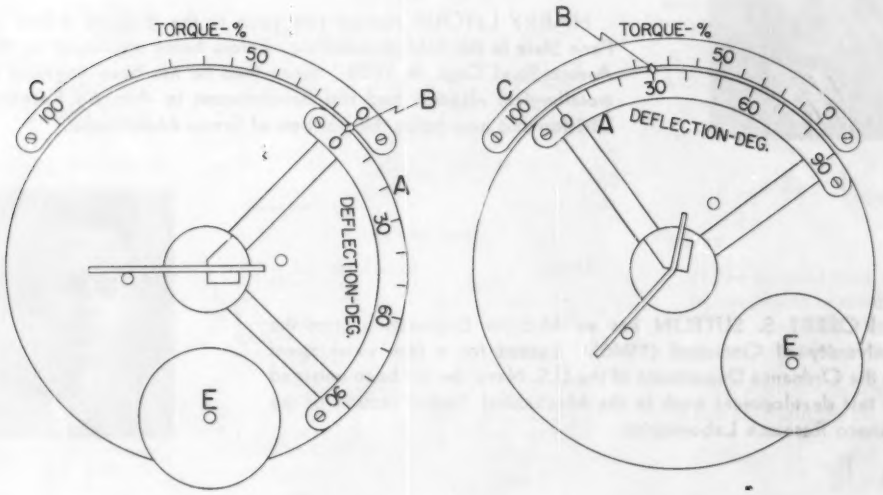


Fig. 5.—Olsen Stiffness Tester of 50 in-lb Capacity with the Modified Inverse Scale System.



Olsen indicating System



Modified Indicating System

Fig. 6.—Diagrams Illustrating Modifications of the Indicating System of the 50 in-lb Capacity Olsen Stiffness Tester.

release the motor lever and reverse the vise by the hand crank until the load again indicates zero. The permanent set angle is the deflection reading.

In step 5 it is difficult for one operator to note the load indication "on the fly" at given increments of deflection because of the distance between the two pointer and scale systems (see Figs. 1 and 3 (upper diagrams)). The modifications shown in Figs. 2 and 3 (lower diagrams) overcome this difficulty.

Test Procedure for 6 in-lb Tester Using Inverse Scale System:

Load and deflection readings for the 6 in-lb Olsen stiffness tester are greatly simplified by eliminating the deflection pointer and substituting at its place of attachment an inverse deflection scale. The deflection scale on the dynamometer (shown painted out in Fig. 2) is retained only because it is a part of the weighing system.

The original and modified indicating systems for the 6 in-lb capacity machine are shown schematically in Fig. 3. The letters in Fig. 3 identify the machine parts as follows:

Deflection pointer, *A* (original Olsen system), or inverse scale (modified system) attached to the specimen vise. At the beginning of the test it is adjusted to indicate zero angle. During the test it is rotated at a constant angular velocity by the motor or crank.

Torque indicator, *B*, attached to the pendulum dynamometer which reacts against the free end of the test specimen. In the modified system, *B* also indicates the deflection.

Torque scale, *C*, which shows the per cent of torque for the range selected.

Deflection scale, *D*, attached to the pendulum dynamometer of the original Olsen machine.

Pendulum weights, *E*. Torque capacity ranges for this machine are from 0.10 to 6 in-lb by 0.25 in-lb increments.

In all scales each division represents either 1 per cent torque or 1 degree of deflection. Only the major divisions are shown in the diagrams.

The substitution of a deflection scale, *A*, for the pointer, *A*, in the Olsen indicating system permits the bend angle to be read at the same position and with the same pointer, *B*, as the torque reading. In the Olsen system the deflection and torque readings are indicated by separate pointers, *A* and *B*, spaced several inches apart.

Modification of the 50 in-lb Tester:

The changes in the 50 in-lb Olsen stiffness tester are similar in principle to those made in the 6 in-lb machine. Figures 4 to 6 show the original Olsen and the modified 50 in-lb testing machine. The letters in the schematic drawings of Fig. 6 have the same meaning as those in Fig. 3. The torque capacity ranges for this machine are from 2 to 50 in-lb by 2 in-lb increments.

The operation of the larger machine is simplified by removing the deflection pointer, *A* (upper diagrams of Fig. 6), and substituting a deflection scale, *A* (lower diagrams). A small diamond-shaped indicator (*B* in lower diagrams) is mounted on the outer edge of the dynamometer disk between the deflection scale, *A*, and the torque scale, C. It serves to mark both the angle of bend and the torque applied at any time during the test. This arrangement permits the operator to load the specimen continuously and read loads accurately at intervals of 5 degrees or less. The circle of vision requiring the operator's attention is approximately 0.1 in. in diameter as compared to a separation of several inches between scales of the standard machine. Furthermore, the weighing system is made less confusing to the operator by the removal of the deflection pointer.

The modified instruments have been in use in our research and manufacturing divisions for four years and have given very satisfactory performance.

Acknowledgment:

The authors are grateful to R. H. Heyer for his many helpful suggestions in the preparation of the manuscript and to J. R. Myers for making the schematic drawings.

The Authors . .

HARRY LaTOUR studied two years in the graduate school of Penn State in the field of metallurgy before being employed by the Armco Steel Corp. in 1938. Since then he has been engaged in metallurgical research and test development in Armco's Research Division and now holds the position of Senior Metallurgist.

ROBERT S. SUTTON has an M.S. in Engineering from the University of Cincinnati (1946). Except for a few years spent in the Ordnance Department of the U.S. Navy, he has been engaged in test development work in the Mechanical Testing section of the Armco Research Laboratories.

A Tension Impact Test For Sheet Metals*

By Carl W. Muhlenbruch

SYNOPSIS

Accelerated use of stainless steel and low-alloy steel sheet materials in aircraft, railroad, and transportation vehicle applications has turned the spotlight on fracture toughness.

The author in a previous paper showed that a tension impact test would readily evaluate this property. Now the author has developed test specimens and fittings to determine the impact strength of sheet metals up to 0.125 in. thick. The method of machining the fittings and specimens as well as permissible tolerances for satisfactory test results are reported. Two types of fittings and test specimens are described, one for the determination of basic fracture toughness values and the other for an evaluation of notch sensitivity.

Test data are reported for a number of materials. These data show duplication comparable to that usually obtained in impact testing. Lack of surface distortion in the shanks is taken as evidence of the effectiveness of the specimen design. This has been further verified by comparing fracture toughness values with the area under the true stress-true strain diagram at the ultimate load. A method is presented for obtaining the ultimate static true stress from a true stress *versus* log true strain relationship for the plastic range just before and after the ultimate load.

APPLICATION of stainless steel and low-alloy steel materials to aircraft, railroad, and transport vehicles has led to a need for knowledge of the fracture toughness of these materials in sheet form. This property is readily evaluated from the tension impact test as the area under the true stress - true strain diagram at the ultimate load, as the author has shown in a previous previous paper.[1]

The use of a pack technique, as in compression testing of sheet metals, and the Charpy or Izod test was considered unsatisfactory on several points. The variation in the striking edge, variations between impact testing machines of like and different manufacture, and variables in machining the specimens were considered as involving too many uncontrollable variables. The tension impact test has the advantage of being a quantitative rather than a qualitative test and permits correlation with stress-strain relationships.

A study of the engineering literature from 1919 to date disclosed no device for tension impact testing of sheet materials that can be used in present commercially available impact testing machines. Charpy or Izod test specimens are commonly cut from metal plate, and some special devices for tension impact testing of plate specimens have been developed.

Although the method of preparing specimens and testing them, as presented in this paper, has been used for more than 400 tests, the paper is intended to encourage interest in this area of impact testing. It is hoped that others will try the method as a means of further evaluating the procedure and the apparatus.

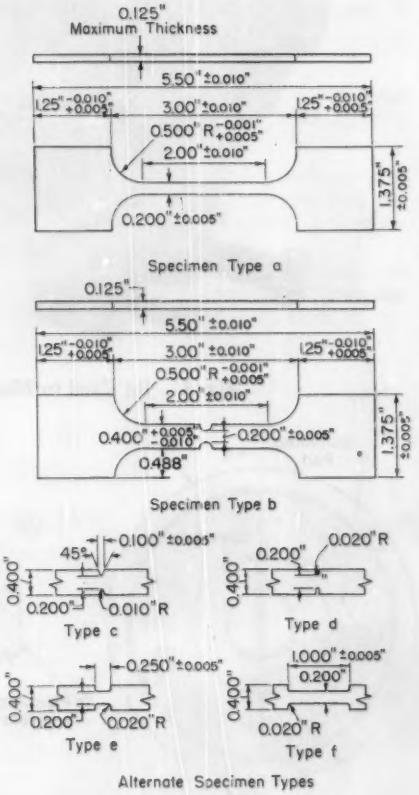


Fig. 1.—Tension Impact Specimens for Sheet Materials.

Object:

The objective of this study was threefold as follows:

1. To develop a device to permit tensile impact loading of test specimens cut from metal sheets, this device to be usable in as many commercially available impact testing machines as possible.
2. To develop a satisfactory method of correlating the results of tension impact tests obtained with the apparatus with stress-strain relationships for the material.
3. To evaluate the performance of the apparatus and method at room and low temperature.

Test Specimen Design:

In order to evaluate the basic property of fracture toughness, a sheet metal specimen had to be developed so that the tension impact blow would be applied to a measurable volume. It was decided that any wedge type of gripping device would be too large and bulky to handle. The simplest way of simulating the threaded shank of a standard tension impact specimen was to use a very wide shank for the sheet metal specimen, with generous fillets providing a smooth transition from large to small section. The maximum capacity of 220 ft-lb of the impact machine used, the known fracture toughness of some materials, and the decision to use a 2.00-in. test length led to a 0.20-in. test width for a 0.125-in. maximum specimen thickness. The amount of elastic energy E_s stored in the shank in the form of tensile stress is given by

$$E_s = \left(\frac{P}{w_s t}\right)^2 \frac{w_s t L_s}{2E}$$

where:

P = applied load, lb,
w_s = width of shank, in.,
t = specimen thickness, and
E = modulus of elasticity, psi.

The corresponding energy E_t stored in the test section is

$$E_t = \left(\frac{P}{w_t t}\right)^2 \frac{w_t t L_t}{2E}$$

where:

w_t = width of test section, in., and
L_t = effective length of test section, in.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at the Fifty-sixth Annual Meeting of the Society, June 28–July 3, 1953.

[1] Carl W. Muhlenbruch, "Elastic and Fracture Toughness Studies of Stainless Steel," *Proceedings*, Am. Soc. Testing Mats., Vol. 49, p. 738 (1949).

Neglecting inelastic behavior and shearing stresses and adjusting L_s, L_t to include the transition region between shank and test section leads to

$$100 \frac{E_s}{E_s + E_t}$$

for the percentage energy stored in the shank. In the case of a standard round impact specimen[1] this ratio is about 5 per cent. In the present case, with

$$w_t = 0.20 \text{ in.}$$
$$L_t = 2.00 \text{ in.}$$
$$L_s = 0.70 \text{ in.}$$

a 5 per cent ratio would be obtained with

$$w_s = 1.33 \text{ in.}$$

A shank width of 1.375 in. was selected since it permitted the use of a fillet of 0.500 in. radius. Thus the dimensions of the specimen type *a* shown in Fig. 1 were evolved. The tolerances shown in this figure were based on actual measurement of finished specimens, as will be discussed later.

Figure 1 gives some alternate specimen types. These are intended to permit an evaluation of notch sensitivity. A special set of grips must be provided for the alternate specimen types to accommodate the 0.40 in. width at the shank end. An advantage of types *d*, *e*, and *f* is that they have the same radius at the base of the notch and differ only in volume. It is proposed that a rectangular grid be applied, by scribing or photographic technique, to the surface of specimens of this type. A study of the elongation pattern in the vicinity of the notch may be helpful in evaluating notch sensitivity. No specimens of this type are reported in this paper.[2]

The clamping jig used to machine the reduced portion of the test specimens is shown in Fig. 2. A pack of specimens is first machined to the proper width and approximate length. It is then held in the clamping jig, and the reduced section is formed with a milling cutter. The pack is turned over and supported on the alignment block while the other reduced section is milled out. With the alignment block still in place, the pack is placed into the jig shown in Fig. 3. The projecting ends are then milled to length. Reversing the pack end for end with the alignment block still in place positions it for the final end milling operation. The method is fast and does not require an exceptionally skilled machine operator.

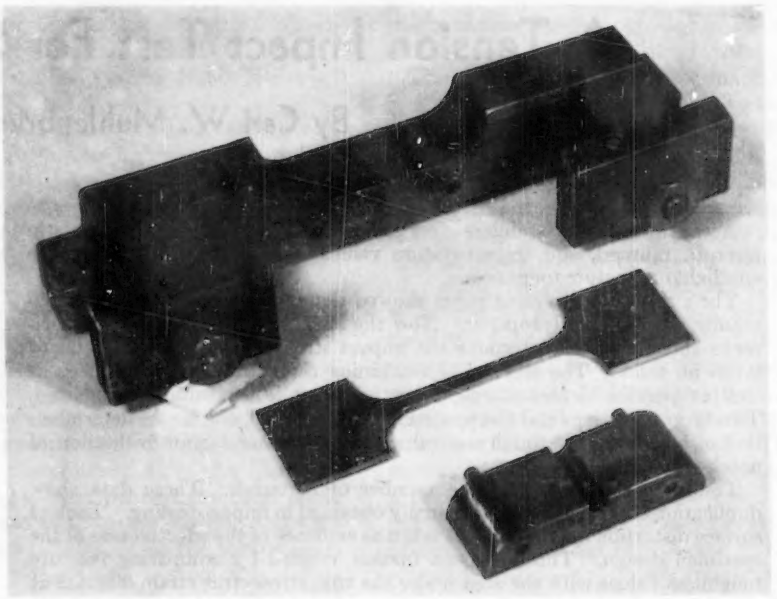


Fig. 2.—Clamping Jig and Alignment Block Used to Machine Reduced Center Section of Specimen.

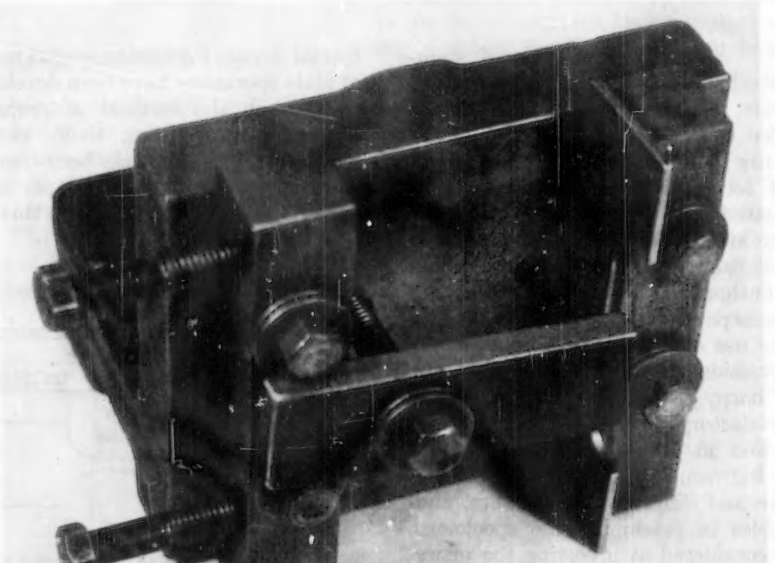


Fig. 3.—Jig Used to Machine Specimens to Length.

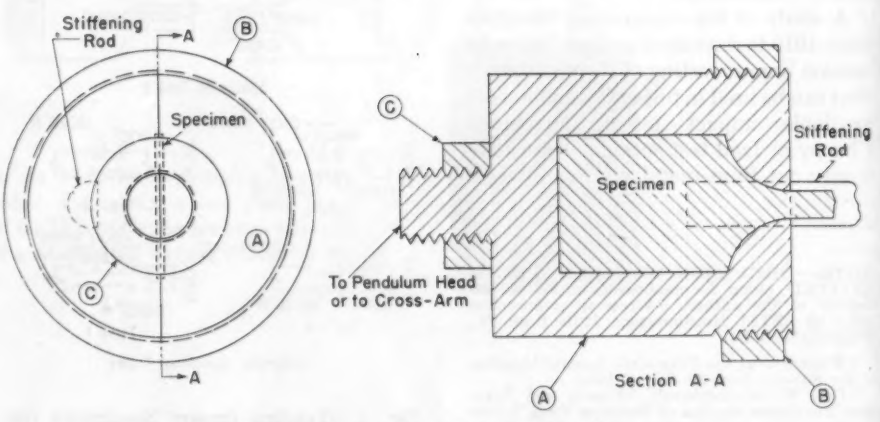


Fig. 4.—Assembly of Grips and Fittings.

[2] Specimens of this type are reported in C. R. Mayne, V. N. Krivobok, and C. W. Muhlenbruch, "Tension Impact Strength and Strain Distribution at Room and Sub-Zero Temperatures of Stainless and Other Steels," Symposium on Metallic Materials at Low Temperatures, Am. Soc. Testing Mats., (1953). (To be issued as separate publication *ASTM STP No. 158.*)

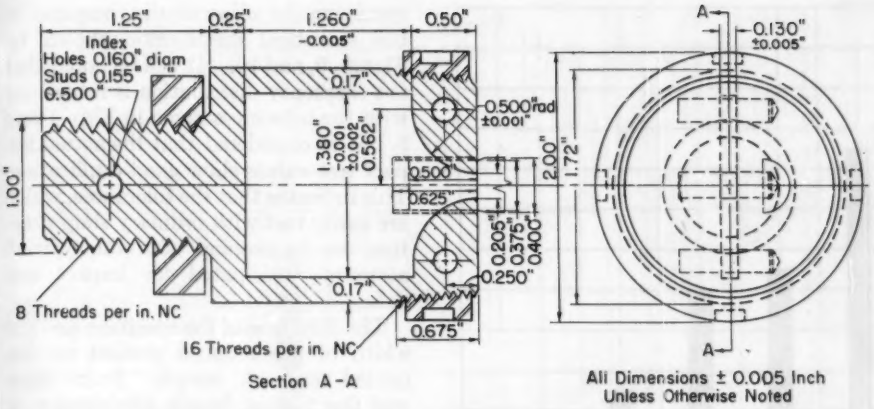
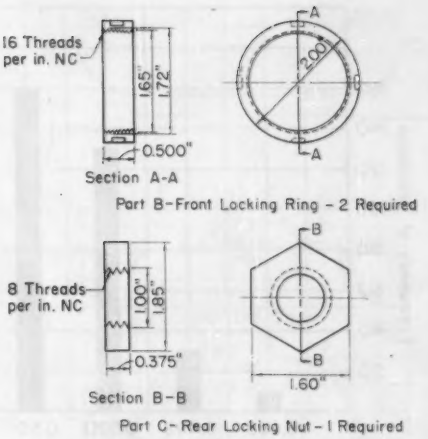


Fig. 5.—Details of Grips and Fittings.



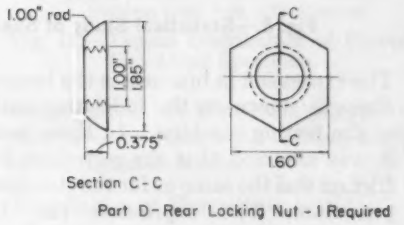


Fig. 6.—Fittings for Sheet Impact Grips.

Grip Design:

The function of the grips is to transmit the load to the specimen as uniformly as possible. It is important that the grip and specimen assembly be easily placeable in the testing machine. Since tension impact specimens and their supplementary fittings are commonly screwed into the pendulum head, a round gripping device seemed to offer the most advantages. Additional considerations such as ease of fabrication with the lathe, locking into the pendulum head, and assembly of the unit with gloved hands at low temperatures led to the design shown in detail in Figs. 4 to 7.

As shown in Fig. 4, the specimen is held in the split grip sections. These are held together by the front locking ring and the rear locking nut. Because the apparatus has been used on a Riehle impact testing machine, two types of rear locking nuts have been designed. Type *C* is on that grip which fits into the pendulum head. Type *D* has a radius to mate with that in the crossarm which catches the other grip.

The indexing pins make for easy assembly of the two grip halves, especially when shim stock is used in the grip cavities with specimens less than 0.125 in. thick. Holes around the periphery of the front locking ring permit the use of special spanner wrench. The stiffening rod is necessary to prevent bending the specimens as the pendulum falls. It fits freely into one grip and is threaded into the other. The complete assembly of specimen and grips is longer than the standard tension impact specimen. It was therefore necessary to increase the length of the striking supports so that contact is made with the crossarm just as the pendulum head is in the maximum downward position. The length of this extension was 4.5 in.

The grip bodies were made of an alloy steel selected for its toughness. The chemical analysis furnished by the steel supplier indicated 0.25 per cent carbon, 0.96 per cent manganese, and 2.78 per cent nickel. Rod stock of 2 in. diameter was used.

Correction for Weight of Grips:

Impact test data cannot be read directly from the indicator scale of the testing machine but must be corrected for the weight of the grips. If the initial and final angles of the pendulum are a and b, respectively, the kinetic energy before impact will be

$$E_p = W_i R_g (1 - \cos a) - aF = W_i H - aF$$

and the final energy after fracture of the specimen will be

$$E_f = W_f R_g (1 - \cos b) + bF = W_f H' + bF$$

where:

W_i = weight of pendulum head plus total weight of gripping device, lb, = 43.26 + 5.08 = 48.34 lb,

W_f = weight of pendulum head plus weight of one-half of gripping device, lb, = 45.80 lb,

R_g = distance from center of rotation to center of gravity, ft,

F = correction for friction and windage, ft-lb per deg,

H = initial height of center of gravity of pendulum head above striking position, ft,
= 2.543 ft for 110 ft-lb range,
= 5.085 ft for 220 ft-lb range, and

H' = final height of center of gravity of pendulum head above striking position, ft.

Except for losses in the machine, the impact strength, I, is the difference between the kinetic energy and the final energy. Letting the total weight of the gripping device be $2w$ and the weight of the pendulum head W, the expression for $E_p - E_f$ will reduce to

$$I = [W(H - H') - F(a - b)] + w(H - H') + wH$$

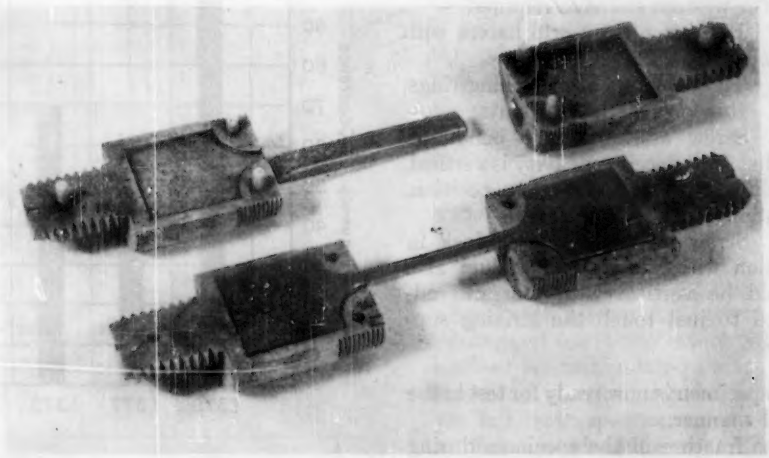


Fig. 7.—Type *A* Specimen in Grips Without Locking Nuts or Rings in Place.

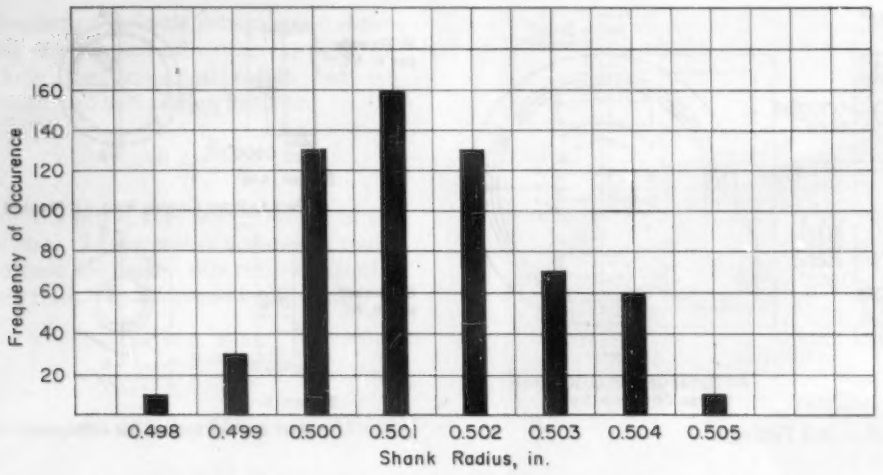


Fig. 8.—Statistical Study of Shank Radii—Standard Deviation 0.0013 in.

The expression in brackets is the impact strength shown on the indicating scale of the testing machine. In these tests it was assumed that the correction for friction was the same as for the standard pendulum. The expression can be written

$$I = [(H - H')(W + w) - F(a - b)] + wH$$

The expression in brackets is the normal indicator reading corrected for the weight of one half of the grips in the ratio $(1 + (w/W).)$ This value was 1.059. Since the back portion of the grip falls from the pendulum, the value wH drops out of this expression.

Test Procedure:

The assembly of the grips and their placement in the pendulum head is performed in the following order:

1. Slip both front locking rings over stiffening rod with threads properly orientated.
2. Place grip halves from opposite ends on a flat surface, specimen cavity up and with stiffening rod engaged.
3. Place specimen into grip cavity, with or without shims as required.
4. Position mating grip halves with aid of indexing holes.
5. Tighten both front locking rings.
6. Run on rear locking nuts.
7. Screw assembly into pendulum head so that specimen cavity is vertical. Pendulum is in lowered position. Tighten rear locking nut *C*.
8. Screw on crossarm and lock in position with nut *D*. Pendulum arm should be vertical with crossarm adjusted to just touch the striking supports.

The specimen is now ready for test in the usual manner.

The fracture of the specimen during testing makes for easy removal of the grips. A cork-lined catcher box should be provided to prevent damage to the end of the broken specimen as the one grip falls.

When low-temperature tests are to be performed, the impact testing machine, grips, and specimens are placed in a cold room at the proper temperature for at least 12 hr preceding the time of testing. Operators wear Arctic clothing and disassemble the grips with gloved hands.

Typical Test Results

Critical Dimensions of Specimens:

The important specimen dimensions relative to the machining operation and fit in the grips are shank radius, shank width, and shank length. A study of 150 specimens, including all those reported herein and random sampling of specimens for other studies, resulted in the statistical distribution shown by Figs. 8, 9, and 10. It will be noted that the frequency distribution is in keeping with the tolerances given in Figs. 1 and 5. It is considered that the actual impact test values show good duplication. This indicates that the tolerances, which are easily met with ordinary shop practice, are in keeping with the over-all accuracy anticipated for impact test data.

The thickness of the specimen and the width of the reduced portion are recorded for each sample. From these and the 2.00-in. length the volume of material absorbing the energy of fracture is determined.

Fracture Toughness:

Table I gives impact strengths and other data for four commonly used metallic sheet materials. These were purchased on the open market and no chemical analysis was available. Specimens were cut parallel and perpendicular to the direction of rolling and were tested at room temperature and at −40 F.

While there is some variation in the impact strengths in Table I, they are well within the range usually encountered in impact testing. Trial specimens were used to determine whether the 110 or 220 ft-lb range should be used.

A study of Table I will indicate the value of this type of test in providing quantitative data and in showing the effects of rolling direction, as well as

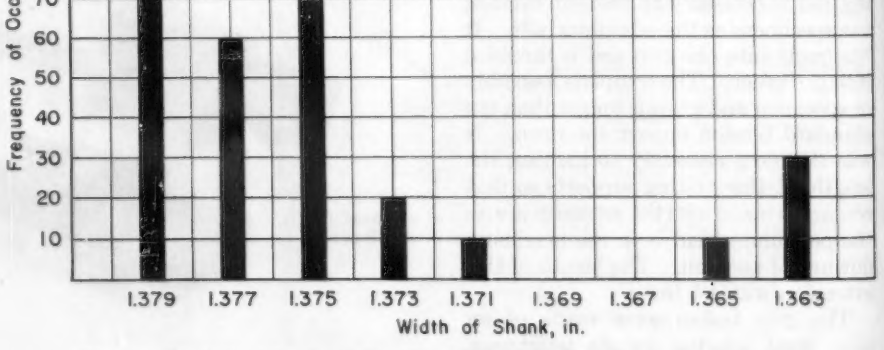


Fig. 9.—Statistical Study of Shank Width—Standard Deviation 0.0005 in.

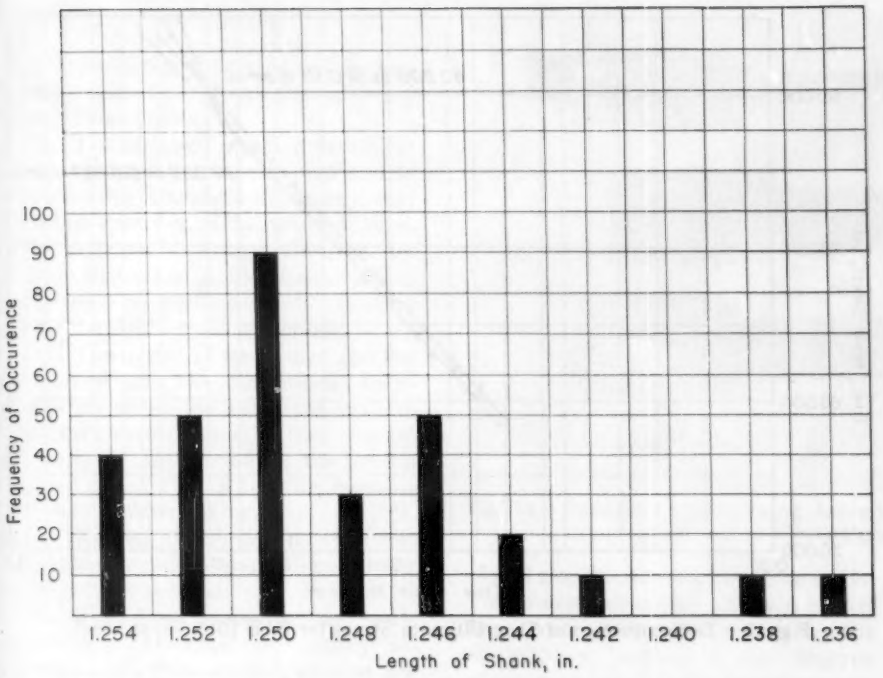


Fig. 10.—Statistical Study of Shank Length—Standard Deviation 0.043 in.

TABLE I.—TENSION IMPACT TEST SPECIMENS AND RESULTS.

Specimen Number[a]	Material	Testing Temperature, deg Fahr	Fracture Toughness			Elongation, per cent	
			Ft-lb[b]	In-lb per cu in.	Average	In 2 in.	Maximum in 0.25 in.
MSWR1	SAE 1015 mild steel, 0.105 in. thick	70	65.3	18 500	19 000	29	41
MSWR2			64.8	19 300		28	40
MSWR3			66.4	19 200		27	37
MSXR1			72.4	20 400	19 900	31	42
MSXR2			69.4	19 900		25	37
MSXR3			68.1	19 400		28	40
MSWL1		−40	25.7	7 560	7 280	24	40
MSWL2			27.0	8 100		24	37
MSWL3			21.2	6 170		23	36
MSXL1			35.2	9 870	9 250	20	38
MSXL2			28.1	7 980		20	34
MSXL3			33.9	9 900		17	36
ALWR1	3 S-H14, 0.125 in. thick	70	14.7	3 400	3 460	14	36
ALWR2			13.9	3 330		13	37
ALWR3			14.8	3 640		15	40
ALXR1			11.9	2 720	2 560	11	33
ALXR2			10.6	2 510		11	37
ALXR3			10.3	2 460		10	37
ALWL1		−40	16.7	4 200	4 250	15	38
ALWL2			17.3	4 330		16	36
ALWL3			17.3	4 230		16	37
ALXL1			13.5	3 220	3 400	13	33
ALXL2			15.4	3 560		15	37
ALXL3			14.0	3 420		12	37
301WR1	301 half-hard stainless steel, 0.080 in. thick	70	112.4	42 100	42 400	24	38
301WR2			110.7	41 800		25	38
301WR3			117.3	45 300		28	39
301XR1			75.6	28 300	28 900	17	32
301XR2			76.1	28 300		22	35
301XR3			79.4	30 100		17	35
301WL1		−40	157.7	59 900	58 400	32	38
301WL2			160.9	59 600		29	36
301WL3			149.5	55 700		29	31
301XL1			135.9	51 700	54 700	24	34
301XL2			156.6	58 400		29	37
301XL3			144.7	53 900		27	35
302WR1	302 annealed stainless steel, 0.088 in. thick	70	138.8	47 400	45 800	29	38
302WR2			136.6	45 300		27	38
302WR3			129.6	44 700		27	36
302XR1			113.8	39 700	36 500	21	36
302XR2			105.3	35 500		20	33
302XR3			102.6	34 200		19	36
302WL1		−40	152.3	51 200	50 500	27	32
302WL2			140.4	49 600		25	36
302WL3			144.7	50 700		30	39
302XL1			184.7	62 700	60 700	30	37
302XL2			172.3	58 500		29	38
302XL3			180.4	60 700		29	33

[a] *W* indicates with grain (rolling direction); *X* indicates cross grain.
[b] Corrected for increased pendulum weight.

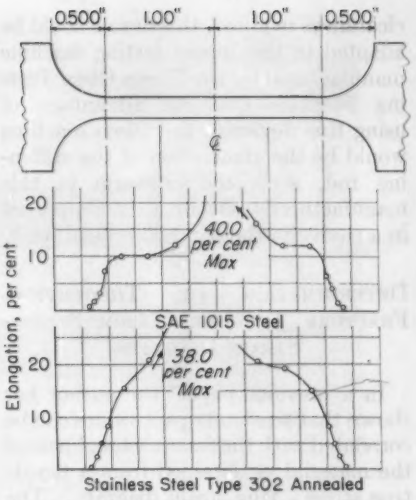


Fig. 11.—Typical Distribution of Elongation Along Specimen.

temperature. It is not the purpose of this paper to discuss the relative merits of the materials tested.

Distribution of Elongation:

Figure 11 gives typical distribution patterns for elongation along 2 in. of the reduced portion of several test specimens. These data are presented as representative. Detailed studies were made of one sample from each of the room temperature specimen series tested.

It will be noted from Fig. 11 that there is very little elongation in the shank area of the specimen on either side of the reduced center section. Only rarely did the elongation at the beginning of the fillet exceed 10 per cent. As shown in the figure, this dropped off rapidly and reached zero approximately 0.18 in. from the beginning of the fillet radius. This was further checked by placing machinist bluing on the surface of the sample at either end observing the flaked area at the end of the test. A small bulb of distorted area was formed at either end of the reduced center section, within the 0.18-in. limit indicated above. It is therefore recognized that the energy load is being transmitted to the specimen through the radii in the grips and that the energy being absorbed by the shanks is very small. The actual volume of material represented by these end areas is actually less than 5 per cent maximum value considered in the design of the type A specimen.

Suggested Improvements:

The front locking ring could be replaced with a snap ring, giving an advantage at low temperature, when the device is manipulated with gloved hands. To make for easier fabrication the full depth specimen cavity could be cut into one side of the grip. With some redesign of the grips to accommodate the

clearances required, this device could be adapted to the impact testing machine manufactured by the Tinius Olsen Testing Machine Co. An advantage of using this device in the Olsen machine would be the elimination of the stiffening rod, since the crossarm in this manufacturer's machine is supported in a cavity in the pendulum head itself.

Determination of Theoretical Fracture Toughness from Stress-Strain Diagrams

In a previous paper[1] the author has shown that tension impact values can be correlated with the fracture toughness of the material as obtained from a tensile true stress - true strain diagram. The fracture toughness value is obtained as the area under this stress-strain relationship at the ultimate load stress. Generally, there is difficulty in obtaining the strain corresponding to the ultimate load. This is particularly true for materials such as stainless steel, where localized work-hardening effects cause the conventional stress-strain diagram to be extremely flat in the region of the ultimate load.

An improved technique for locating the ultimate load and corresponding strain is based on the idea of the $S-q'$ curve proposed by MacGregor.[3] The true stress is plotted to a Cartesian coordinate scale against the log of true strain. Typical plots of this type were shown in Figs. 12 and 13. The true stress at the ultimate load is found as the point of intersection of the straight-line portion of the diagram representing the plastic range prior to the ultimate load and the straight-line portion of the diagram representing the increased rate of distortion beyond the ultimate and approaching the fracture load.

The technique suggested above has been used in obtaining the theoretical fracture toughness values from room temperature stress-strain relationships for the materials included in this investigation. These are recorded in Table II and are compared with the actual fracture toughness values as obtained from the tension impact test. It will be noted from Table II that there is much better agreement than in previous work reported by the author in which the true stress ultimate load and the corresponding strain were obtained in the conventional fashion. The single exception to this is the series of aluminum specimens. The greater error observed for these specimens appears to be due to the relatively small plastic range for the material.

[3] C. W. MacGregor, "The Tension Test," *Proceedings*, Am. Soc. Testing Mats., Vol. 40, pp. 526–529 (1940).

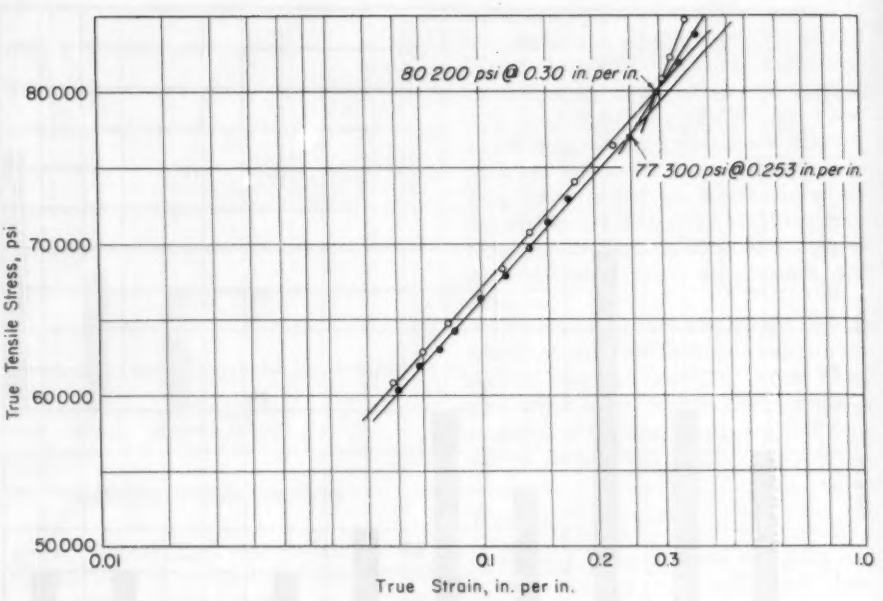


Fig. 12.—Determination of True Ultimate Stress for SAE 1015 Sheet Steel.

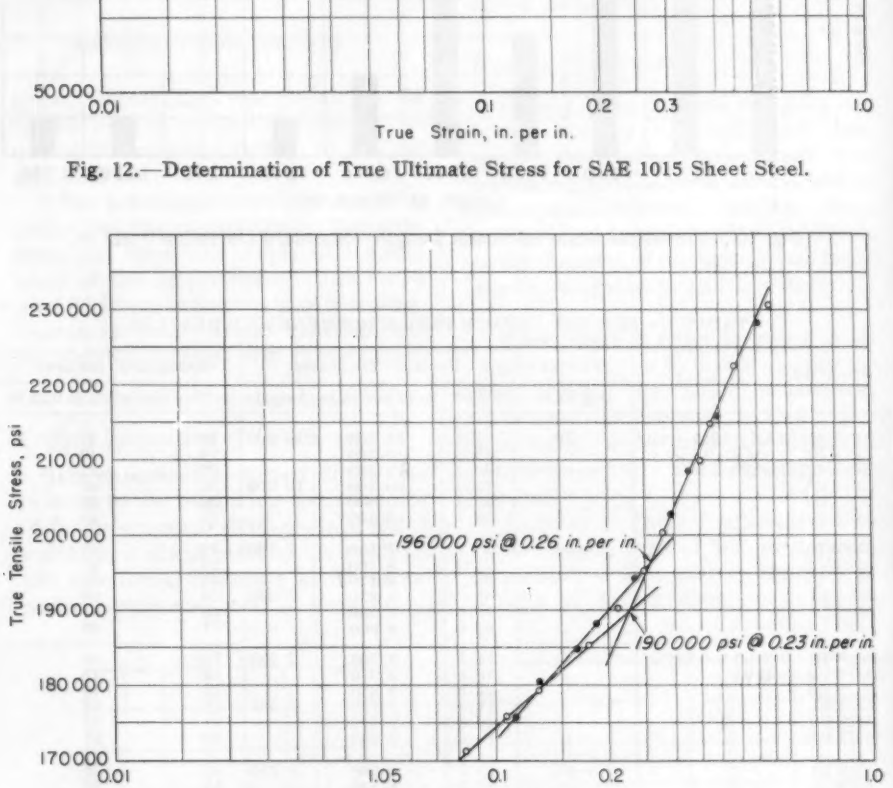


Fig. 13.—Determination of True Ultimate Stress for Type 301 Half-Hard Stainless Steel.

TABLE II.—COMPARISON OF THEORETICAL AND ACTUAL FRACTURE TOUGHNESS.
All data for 70 F.

Specimen Series	Material	Fracture Toughness, in-lb per cu in.		
		Stress-Strain Diagram		Impact Test
		Individual	Average	
MSWR	SAE 1015 mild steel	18 900	18 750	19 000
		18 600		
MSXR		18 900	17 950	19 900
		17 300		
ALWR	3 S-H14 aluminum	2 720	2 640	3 460
		2 560		
ALXR		2 210	2 320	2 560
		2 420		
301WR	301 half-hard stainless steel	43 700	42 000	42 400
		40 300		
301XR		33 350	32 150	28 900
		30 950		
302WR	302 annealed stainless steel	45 200	44 750	45 800
		44 300		
302XR		38 750	38 130	36 500
		37 500		

Conclusions

The use of this apparatus and the test results seem to warrant the following general conclusions:

1. The proposed gripping device for tension impact testing of sheet metals satisfactorily transmits the energy load to a test specimen of the proposed type. The amount of energy absorbed by plastic distortion in the shanks is less than the 5 per cent commonly found for round tension impact specimens.
2. The design of the device and the specimens and the dimensional tolerances permitted are such that uniform test results are obtained, at least as good as normally anticipated for the tension impact test. This is true for room or low-temperature testing.
3. Neither the device nor the test specimens requires unusual machining skill for preparation.
4. The test procedure is easily followed. The grips are readily assembled and disassembled, even at low temperatures.
5. Quantitative values of fracture toughness can be obtained for relatively thin sheet metals. The test can be used to ascertain the influence of rolling direction and temperature on this property.
6. The theoretical fracture toughness of a material can be obtained as the area under the tensile true stress-true strain diagram at the ultimate load. This value correlates closely with actual fracture toughness, when taken from a plot of true stress *versus* long true strain. The true stress at the ultimate load is found as the point of intersection of the straight-line portion of the diagram representing the plastic range prior to the ultimate load and the straight-line portion of the diagram representing the increased rate of distortion beyond the ultimate.

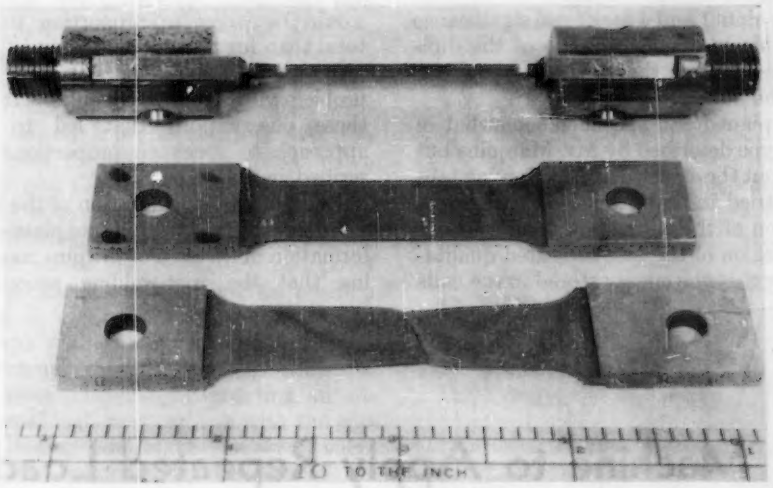


Fig. 14.—Specimen and Gripping Assembly Used for Tension Impact Tests of Sheet Metals at Westinghouse Research Laboratories.

The Author . . .

CARL W. MUHLENBRUCH is Associate Professor of Civil Engineering, Northwestern Technological Inst., where he is in charge of courses in mechanics and properties of materials and mechanics of materials laboratory. In addition to consulting work, he has written frequently in ASTM publications and in 1945 he won the Society's Sanford E. Thompson Award.

DISCUSSION

Mr. George C. Lawrie[1] (*presented in written form*).—It is obvious from Mr. Muhlenbruch's paper that he has done a great deal of work in tension impact testing of sheet metals to obtain the data he has presented. Undoubtedly there is a lot to be learned by impact testing of sheet metals in the "as rolled" condition and apparently not very much previous work has been done in this particular field.

As is well known, we manufacture all types and sizes of physical testing machines, but unfortunately we do not have the opportunity to make extended series of tests on any one machine. However, we have arranged to provide this type of fixture as accessory equipment for our impact testing machine. It is, of necessity, modified somewhat in construction from the fixture shown in the paper, but the important dimensions having to do with holding the specimens and the specimen dimensions are the same. The changes incorporated permit:

1. More rapid insertion of specimen, of considerable value at low temperatures.
2. Completely interchangeable gripping parts.
3. One half as many gripping parts for assembly.
4. No correction for weight of specimen holders.

Mr. M. J. Manjoine[2] (*presented in written form*).—The author has described tests specimens and fittings to perform impact tension tests of sheet metals. The same problem arose in our laboratory during the war and the following describes the specimen and grips which we used.

The specimen blank is reinforced by spot welding a tab on each side of the head as shown in the middle of the accompanying Fig. 14. The tabs on each side are ground to align the gage length to the center. Sufficient material is removed to make the thickness of the head about one mill less than the slot of the grip, top of Fig. 14.

A hole is drilled in the center of each head and the gage length is milled using these holes as reference. This milling and the grinding of the heads assure alignment in the axial direction.

The grip is made in one piece and consists of a threaded rod which has been slotted to accommodate the head of the test specimen. A pin through a transverse hole in the grip is used to attach the specimen to the grip. The dimensions of the head of the specimen and the size of the hole are such to insure that no plastic deformation occurs.

The specimens are easily inserted or removed from the grips as the pin has an easy sliding fit.

These grips are extremely light and have proved satisfactory for tension impact testing of sheet materials. The weight of one half of the specimen and grips is only 0.12 lb.

Mr. C. W. Muhlenbruch (*Author*).—The adaptation of this device to the Tinius Olsen impact testing machine, as described by Mr. Lawrie, should prove to be a real boon to research workers.

[1] Chief Engineer, Tinius Olsen Testing Machine Co., Willow Grove, Pa.

[2] Westinghouse Research Laboratories, Westinghouse Electric Corp., East Pittsburgh, Pa.

His points 1 and 4 are of real significance and nicely overcome some of the difficulties of using the apparatus described by the author.

A pinned end specimen somewhat of the type described by Mr. Manjoine but without the spot-welded reinforcing tabs was tried in static tension. An examination of the surfaces of the shanks in the region of the hole indicated qualitatively that the energy stored in the ends would be larger in proportion to the total than for the standard round specimen. A mathematical study of the problem yields the same results. It was these observations that led to the approach to specimen proportions described in the paper.

Undoubtedly the addition of the tabs will minimize the possibility of plastic deformation in the area of the pins, assuming that the spot-welding procedure does not introduce an undesirable residual stress pattern.

Mr. Manjoine apparently bases his feeling of satisfaction on test results obtained for impact strength only. Whether this value would correlate with the fracture toughness obtained from the true stress - true strain diagram is not known but would depend primarily on the stress and energy distribution in the gripped ends.

Machine to Apply Repeated Loads to Large Flexural Members

By A. Roesli, A. C. Loewer, and W. J. Eney

New to this country—a testing machine that simulates the passage of trucks at various speeds over bridge members.

A RESEARCH program being conducted at Lehigh University to investigate the endurance of prestressed concrete bridge members necessitated the development of a testing machine which would apply a repetitive load to simulate the passage of trucks moving at various speeds over a bridge member. Special machines of this type are available in Europe and used in different laboratories abroad.[1] However, it was intended to build such a unit, using only standard parts of equipment available in this country. As this machine is believed to be unique and since others may find it useful, it is described herein. The performance of the machine has been demonstrated by the application of 2,500,000 cycles of loading to two concrete beams, one of which is shown under test in Fig. 1.

Description of Testing Machine and Loading Frame

The testing machine consists of a loading frame, two hydraulic jacks, and a pumping system.

Loading Frame:

As shown in Fig. 1, two 36-in. WF sections 38 ft long, provided with the necessary stiffeners, are spaced 3 ft apart and connected together by means of cross-bracing and diaphragms. Acting as a unit, this base frame is simply supported at the ends, carries the test beam, and provides anchorage for the two hydraulic jacks. Furthermore, two cross members fixed on the base unit can be adjusted to support any length of test beam up to 38 ft at an elevation of 3 ft above the base frame.

The simply-supported end conditions of the test beam are provided by a hinge at one end and a rocker at the other.

The two hydraulic tension jacks are placed at the third-points of the base beam. Each is connected to an adjustable yoke in such a manner that the load is applied at the top of the test beam.

Jacks:

Although the jacks can occasionally be used to produce up to 100 kips (a kip equals 1000 lb) of static load, they were built for a maximum working capacity of 50 kips. They are standard jacks and were not designed for dynamic use.

To determine the applied load, strain gages are mounted on the rods connecting the jacks with the yokes. To record the magnitude of the load, a type K, Baldwin Indicator is used during

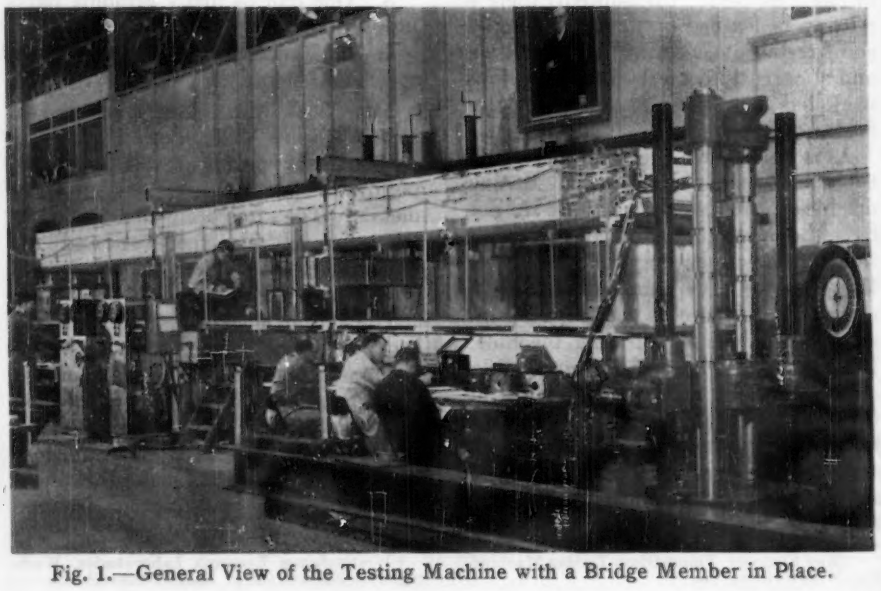


Fig. 1.—General View of the Testing Machine with a Bridge Member in Place.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] See, for example, L. Baes and Y. Verwilist "Grande Installation Mécanique Pour Essa, Durée," *L'ossature Metallique*, May, 1952.

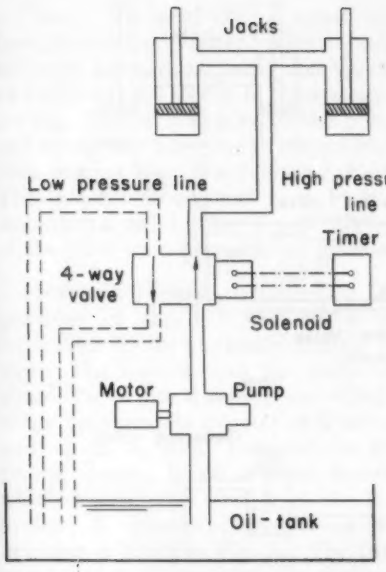


Fig. 2.—Loading Phase of Cyclic Loading Machine.

static tests while a Brush Recorder and amplifiers serve the purpose during dynamic load applications.

Pumping System:

The main parts of the pumping system consist of an oil tank, a 50-hp electric motor, a high-pressure oil pump, a system of valves connected with high-pressure pipe lines, an electronic timing device, and all the necessary control instruments.

Pump.—This high-pressure pump is an axial piston type designed for 5000-psi maximum pressure. By changing the length of the stroke of the pumping pistons, the volume of delivered fluid is regulated by automatic control. The maximum capacity of the pump is 20 gal per min.

Powered by an electric motor at 1200 rpm, the pump draws oil from the tank and delivers it to the pressure line which is connected with the jacks.

Four-Way Valve.—Included in the pressure line is a four-way valve, which in turn is connected with two separate low-pressure lines leading into the oil tank. A solenoid, controlled by an electronic timer, shifts the spool of the four-way valve alternately in two different positions.

In the first position, the pressure line from the pump is connected with the pressure line to the jacks. The pressure in the jacks is then built up and consequently the load is applied to the test beam, while the low-pressure lines are connected together without any resulting action (Fig. 2).

In the second position of the spool, the pressure line coming from the pump is connected with one of the low-pressure lines. The oil flows from the pump through the four-way valve into this line and back into the tank without doing any work. At the same time the pressure line joining the jacks with the four-way valve is connected with the second low-pressure line. As the oil goes through the four-way valve back into the tank, the pressure in the jacks is decreased and the test beam is unloaded. The elastic rebound of the beam under test drives the pistons of the jacks back to their original position (Fig. 3). For special tests it is desired to apply alternating tension and compression forces on specimens. This can be accomplished by connecting an additional high-pressure line with the corresponding port of the four-way valve and the compression chamber of the jacks. The oil pressure by-passed during the unloading period in the present system could thus produce compression forces.

Sequence Valve.—The purpose of this valve is to regulate the working pressure in the system and thereby to control the loads applied to the test beam. This is accomplished by adjusting the valve to a desired pressure setting. No oil passes through this valve until pressure in the main line exceeds the pressure setting. When this condition is reached, the valve automatically by-passes the excess oil into an additional line connecting it to the relief valve (Fig. 4).

Relief Valve.—As mentioned above, an automatic control regulates the volume delivered by the pump. This control is located in the base of the pump and consists of a pressure-operated cam that regulates the length of the

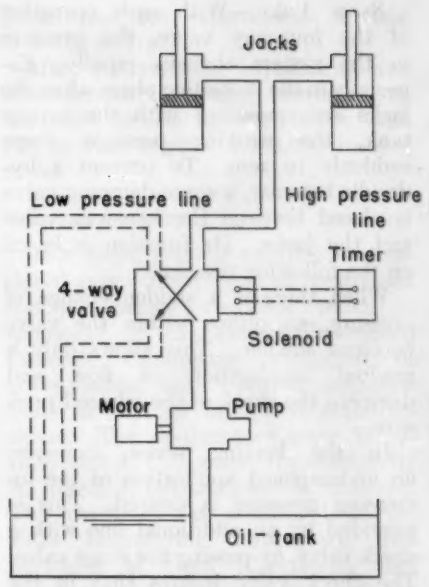


Fig. 3.—Unloading Phase of Cyclic Loading Machine.

pumping stroke of the pistons. This is a comparatively low-pressure device with a maximum working pressure of 300 psi.

To prevent excessive pressure in the control, a relief valve is installed between the sequence valve and the pump. This valve maintains the pressure to the pump control within its safe working range and, by adjustment, permits additional control of the complete system. Oil that is not required to maintain the adjusted working pressure of the relief valve is by-passed directly to the supply tank (Fig. 4).

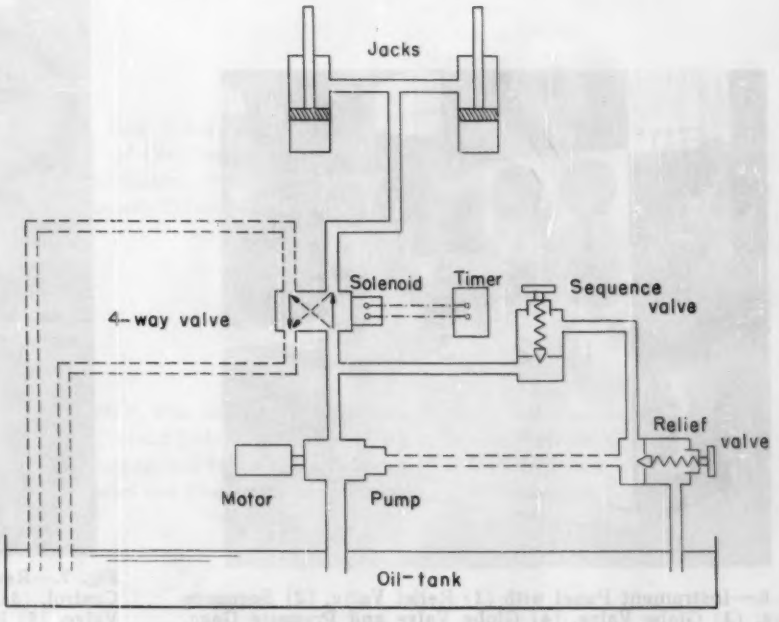


Fig. 4.—Pressure Regulating System.

Surge Valve.—With each operation of the four-way valve, the pressure in the system changes rapidly. Especially in the unloading phase when the jacks are connected with the supply tank, the working pressure drops suddenly to zero. To prevent a hydraulic hammer, a surge-damping valve is placed between the four-way valve and the jacks. Its function is based on the following principle:

When there is a sudden change of pressure, an orifice within the valve becomes smaller. This allows only a gradual acceleration of flow and dampens the shock of the released pressure.

In the loading phase, however, an undampened application of the increasing pressure is desired. This is provided by an additional line with a check valve, by-passing the surge valve. The check valve insures that in the unloading phase all oil is forced to flow through the surge valve.

Additional Valves.—Included in the pressure lines leading from the pump to the four-way valve are a globe valve and a check valve. The globe valve allows an additional adjustment of the oil volume and the rate of increase of the pressure applied to the jacks.

The check valve permits oil flow only in the direction of the four-way valve and therefore protects the pump from a possible back pressure.

Control Instruments.—For the control of the oil pressure, four pressure gages equipped with globe valves are connected with the system at the most important points.

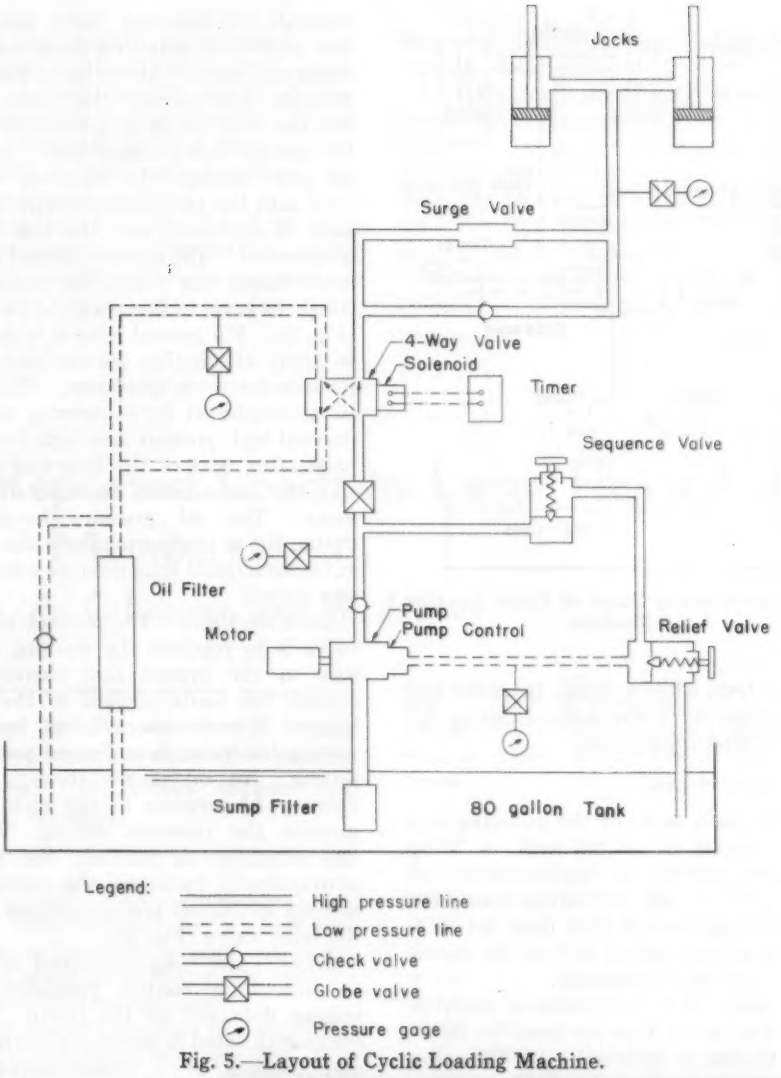


Fig. 5.—Layout of Cyclic Loading Machine.

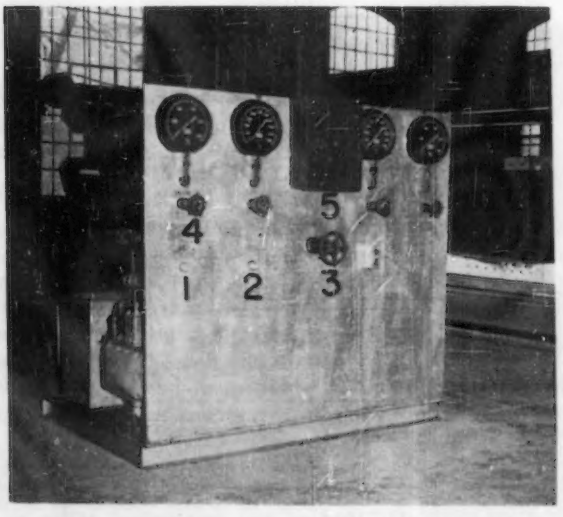


Fig. 6.—Instrument Panel with (1) Relief Valve, (2) Sequence Valve, (3) Globe Valve, (4) Globe Valve and Pressure Gage, and (5) Electronic Timer.

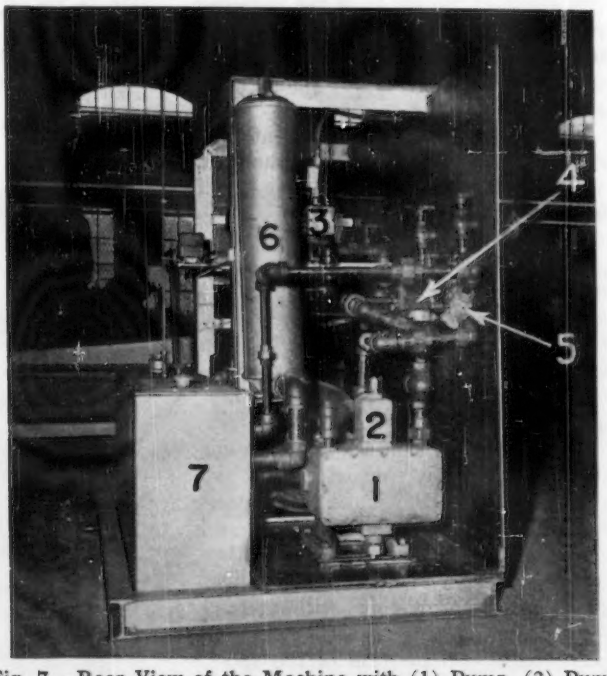


Fig. 7.—Rear View of the Machine with (1) Pump, (2) Pump Control, (3) Solenoid Above Four-Way Valve, (4) Sequence Valve, (5) Relief Valve, (6) Micronic Oil Filter, and (7) Supply Tank.

Filters.—To keep the oil clean and free of foreign matter, which could seriously damage the pump and valves, two oil filters are placed in the system—a sump filter at the inlet of the pump and a micronic filter in the low-pressure lines coming from the four-way valve. The latter is connected to a by-pass including a relief valve for protection of the filter from excessive oil pressure.

Electronic Timing Device.—The two positions of the four-way valve are controlled by an electronic timing device. The loading and the unloading phase can be timed separately within a range between one quarter of a second and about 4 min. Included in this timing device is an electric counter which records the number of the load cycles. A schematic layout of the machine is given in Fig. 5. The front and back of the machine are shown in Figs. 6 and 7.

Performance of the Machine

For the tests of the two bridge members, the machine had to simulate the maximum magnitude and number of loads to be expected during the life-time of a corresponding structure. This was accomplished by applying an oscillating load of 17,700 lb at each third-point. By regulating the pressure and the volume of oil supplied to the jacks, as well as the periods of loading and unloading, a moment-time diagram for the center-line section was obtained, which was closely equal to that produced by the passing of a standard H20-S16-44 truck for which the bridge members were designed. The speed selected for these tests was 40 mph giving a load frequency of 1 cps. The corresponding moment-time diagram for the actual and the experimental loading is shown in Fig. 8.

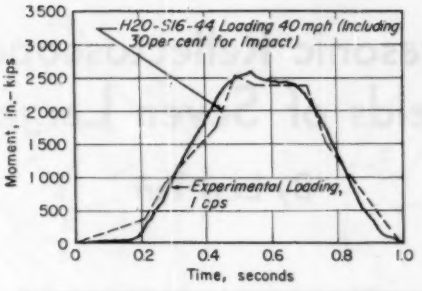


Fig. 8.—Experimental and Actual Moment-Time Diagram.

After the inevitable adjustments and refinements of the trial phase were made, the machine has operated more than 700 hr and applied 2,500,000 loading cycles.

Acknowledgments:

This cyclic loading machine was designed as part of a project on prestressed concrete bridge members which is sponsored by the Lehigh Prestressed Concrete Committee, composed of governmental and research organizations as well as interested manufacturers. The co-directors were W. J. Eney and A. C. Loewer, Jr., assisted by A. Roesli, J. Barrasso, and A. Smislova. The machine was assembled at the Fritz Engineering Laboratory, Department of Civil Engineering and Mechanics, Lehigh University, with the help of K. R. Harpel. K. E. Knudsen later replaced A. C. Loewer as co-director while the machine operation was being perfected.

The authors are very grateful to R. J. Reel of the Denison Engineering Co., Columbus, Ohio, for his help during the design of the machine.

The Authors . . .

A. ROESLI was Engineer of Tests for four years at the Swiss Federal Laboratory for Testing Materials and Institute of Research in Zürich. Since 1952 he has been involved in a research project on prestressed concrete at Lehigh University. He was in direct charge of the design and fabrication of the described machine.

A. C. LOEWER, JR. received his Ph.D. from Johns Hopkins University and later was Associate Professor of Civil Engineering and Director of Concrete Research at Lehigh University. He is now a member of the staff of the Operations Research Office at Johns Hopkins.

W. J. ENEY, after nine years experience in heavy construction and design, joined Lehigh University where he is now Professor of Civil Engineering, and Head of the Department of Civil Engineering and Mechanics and Director of the Fritz Engineering Laboratory.

Experiences with Ultrasonic Reflectoscope Inspection of Main Seam Welds of Seven Large Spheres

By Levi Tarr

On three spheres, reflectoscope indications obtained in weld inspections are compared with radiographs, trepan plugs and Arcair gouging observations or both. Due to favorable correlation of the reflectoscope indications on the three spheres with other methods of inspection, the remaining four spheres were evaluated as satisfactory exclusively by reflectoscope inspection.

WORD had passed around the operating personnel of one of our plants that the quality of welds in some spheres constructed during the war years 1942 and 1943 was inferior. The spheres were located near the operating units as shown in Fig. 1. In order to have a definite evaluation of the weld quality, an inspection of the welds was requested. Consideration was given to several methods of inspection. The use of the Sperry ultrasonic reflectoscope was the most promising since it provided a means of inspection during operation of the spheres. Reflectoscope indications on one sphere were checked against radiographs and fairly good correlation was obtained. The reflectoscope was used to check the main seam welds on the remaining six spheres. This report presents our experiences, as correlated with radiographs, trepan plugs, Arcair gouging, in the reflectoscope inspection of three of the seven spheres and evaluates the weld quality of four spheres by an exclusive reflectoscope inspection.

INSPECTION PROCEDURE

The use of the Sperry reflectoscope for weld inspection has been limited because most welds are considered to have too rough a surface for proper interpretation of the reflectoscope indications. Very little information is available on the actual use of the reflectoscope on weld inspection.[1] Even the information furnished by Sperry indicates that it is necessary to have uniform beads for proper interpretation of the reflectoscope indications.[2] Regardless of this information, it was decided to make a reflectoscope inspection of the seven spheres with no particular preparation of the weld seams, since our experimental work indicated that serious defects such as we suspected could be located at a low sensitivity.

Two 48-ft diameter, 1.06 to 1.16-in. shell thickness, 10,000-barrel spherical tanks, Nos. 39 and 40, and five 38-ft diameter, $\frac{11}{16}$ to $\frac{3}{32}$-in. shell thickness, 5000-barrel spherical tanks, Nos. 16, 17, 18, 19, and 20, were inspected. All spheres are of welded construction with ASTM A-10 material. The main seam welds on these spheres were inspected at the junctures of the welds with a Sperry reflectoscope using an angle beam search unit.

As a basis for a reasonable correlation of data, the reflectoscope instrument controls were set for a peak-to-peak scope indication of $1\frac{3}{4}$ in. for a $\frac{5}{16}$-in. vertical lack of penetration defect in a $\frac{7}{8}$-in. thick carbon steel plate and for a peak-to-peak scope indication of $1\frac{1}{4}$ in. for a $\frac{1}{8}$-in. diameter hole drilled in the edge of the test plate. A 2.25-mc angle beam search unit was used. Surfaces adjacent to the seam welds inspected with the reflectoscope were sanded by hand for a strip 4 in. wide each side of the weld to obtain a comparatively smooth surface for reflectoscope inspection. No attempt was made to remove the paint. Both sides of the weld were inspected with the reflectoscope, and a maximum indication from either side was recorded.

A total of 240 ft of main seam welds of No. 39 tank was inspected with the reflectoscope. Inspection was made at junctures for 12 in. along the circular seam (6 in. each side of juncture) and 24 in. along the vertical seam. No. 39 tank was then removed from service and a total of 135 ft of the main seam welds was radiographed and six trepan plugs were taken. A favorable correlation of the radiographs, the reflectoscope data, and the trepan plugs was seen, and it was decided that an exclusive reflectoscope inspection of the remaining spheres would be feasible. Of the remaining spheres, 230 ft of the main seam welds of No. 40 tank and 190 ft of the main

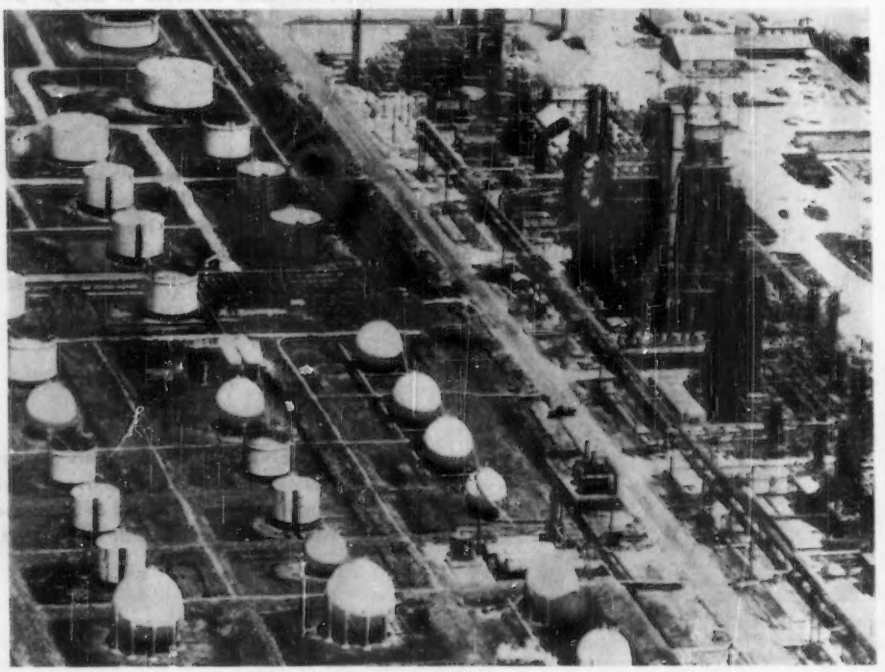


Fig. 1.—Proximity of Spheres to Operating Unit of Plant.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] D. J. Evans, "Ultrasonic Equipment Testing," *Oil and Gas Journal*, Feb. 4, 1952.

[2] Sperry Products, Inc., "Ultrasonic Weld Inspection," Reprint 50-885.

Fig. 3.—Plan of Seam Locations of Tanks Nos. 16 and 20.

Fig. 2.—Plan of Seam Locations of No. 39 Tank. Dark areas were both radiographed and reflectoscoped.

seam welds of each of Nos. 16, 17, 18, 19, and 20 tanks were inspected with the reflectoscope while the spheres remained in service. Inspection was made at junctures for 12 in. along the circular seam and 18 in. along the vertical seam. High reflectoscope indications from the lower circumferential seam of No. 16 tank and No. 20 tank necessitated taking these spheres out of service for further inspection. Several trepan plugs were taken from the above-mentioned seam of both spheres. Although the trepan plugs from No. 20 tank revealed no critical defects, the trepan plugs from No. 16 tank revealed a $\frac{1}{4}$ to $\frac{1}{2}$-in. lack of fusion defect in $\frac{2}{3}\frac{3}{2}$-in. plate. To determine the extent of the defects in No. 16 tank, ten radiographs were taken and an Arcair Gouger was used to gouge out sections of the weld.

Figure 2 shows the radiographed areas and seam locations of No. 39 tank. Figure 3 shows the seam locations of No. 16 tank and No. 20 tank.

Inspection of Spherical Tanks Nos. 39 and 40

The comparison of the radiographs, reflectoscope data, and trepan plugs from No. 39 tank are shown in Table I. It is evident that the reflectoscope indications are not entirely in agreement with the radiographs. However, the reflectoscope indicated the major defects found by radiograph inspection and trepan plug examination.

Figure 4 shows the six trepan plugs taken from No. 39 tank. Figure 5 shows the radiographs of the seams before the trepan plugs were removed. The trepan plugs were taken from the worst representative defects as shown by the radiographs and the reflectoscope indications.

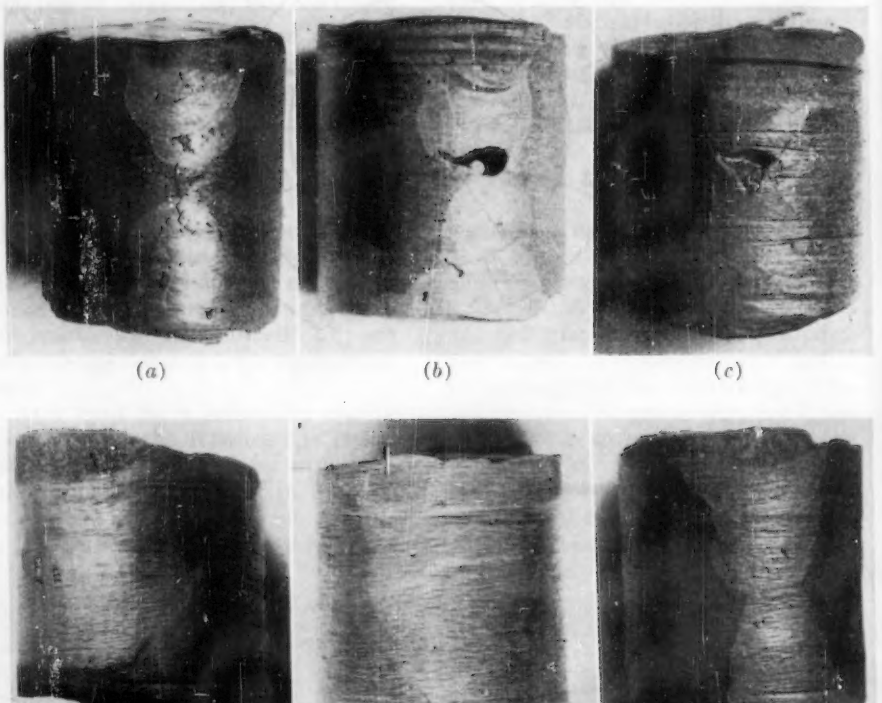
On seam 26B, Figs. 4 and 5, it was evident from the radiograph that the lack of penetration extends 10 in. from the juncture. The reflectoscope indication of 1 in. was given from 6 to 12 in. from the juncture. Although the trepan plug in Fig. 4 shows a $\frac{3}{16}$-in. root bead crack, the opposite side of the plug showed only the $\frac{3}{16}$-in. lack of penetration. The other lack of penetration defects found in No. 39 tank by the radiographs had a maximum length of 5 in. and appeared to be about one third the depth of the defect shown.

The two worst slag inclusions found by the radiographs were in seams 23B and 27B in Figs. 4 and 5. The reflectoscope gave a $1\frac{1}{4}$-in. indication on seam 23B and a 1-in. spot indication 12 in. from the juncture on seam 27B. In the case of seam 27B, where only a 1-in. spot indication was given, it is probable that complete surface coverage with the reflectoscope searching unit was not possible due to excessive weld splatter along the surface adjacent to the weld. The other slag inclusions found in No. 39 tank by the radiographs were minor.

On the circle seam at the top dollar plate, a considerable number of $1\frac{1}{4}$ and $1\frac{1}{2}$-in. indications were given by the reflectoscope, and the radiograph showed general porosity or no defects. A trepan plug was taken at the junction of seam 56TL and a $\frac{3}{16}$-in. crack shown in Fig. 4 was found. A second trepan plug, 5 in. from the juncture, was taken and $\frac{1}{8}$-in. cracks at the bottom of the "V" were present as shown also in Fig. 4; however, the cracks terminated in this second plug. It is entirely possible that other plugs taken where high reflectoscope indications are present, and only porosity or no defects are shown in the radiographs, would show some similar defects. Cracks as found in seam 56TL will not show with normal radiographic techniques.

TABLE I.—SUMMARY OF NO. 39 TANK DATA SHOWING COMPARISON OF 82 RADIOGRAPHS, REFLECTOSCOPE INDICATIONS, AND 6 TREPAN PLUGS.

Radiographs	Maximum Peak-to-Peak Reflectoscope Indication	Trepan Plug Shows
5 show lack of penetration.	4 are $\frac{3}{4}$ in. or less	Seam 26B (Fig. 4)
	1 is 1 in. (see Fig. 5)	$\frac{3}{16}$-in. lack of penetration and $\frac{3}{16}$-in root bead crack
19 show slag inclusions. . .	10 are $\frac{3}{4}$ in. or less	
	4 are 1 in.	
	3 are $1\frac{1}{4}$ in. (see Fig. 5)	Seam 23B (Fig. 4) Intermittent slag
	2 are 1 in. spots (see Fig. 5)	Seam 27B (Fig. 4) Intermittent slag
25 show general porosity. .	13 are $\frac{3}{4}$ in. or less	
	7 are 1 in.	
	5 are $1\frac{1}{4}$ in. (see Fig. 5)	Seam 56TL (Fig. 4) Porosity and $\frac{3}{16}$-in. crack
		Seam 56TL (Fig. 4) Two $\frac{1}{8}$-in. cracks
33 show no defects.	19 are $\frac{3}{4}$ in. or less	
	6 are 1 in.	
	2 are $1\frac{1}{4}$ in.	
	2 are $1\frac{1}{2}$ in.	
	4 are spots (3 are 1 in., 1 is $2\frac{1}{2}$ in.)	Seam 3T (Fig. 4) No defects



(a) (b) (c)

(d) (e) (f)

Fig. 4.—Trepan Plugs from Seams in Tank No. 39 ($\times 1\frac{1}{8}$).

(a) Seam 26B—Trepan plug showing $\frac{3}{16}$-in. lack of penetration and $\frac{3}{16}$-in. root bead crack.
(b) Seam 23B—Trepan plug showing slag inclusion.
(c) Seam 27B—Trepan plug showing slag inclusion.
(d) Seam 56TL—Trepan plug from junction showing $\frac{3}{16}$-in. crack.
(e) Seam 56TL—Trepan plug from 5 in. left of junction showing two $\frac{1}{8}$-in. cracks.
(f) Seam 3T—Trepan plug showing slight porosity.

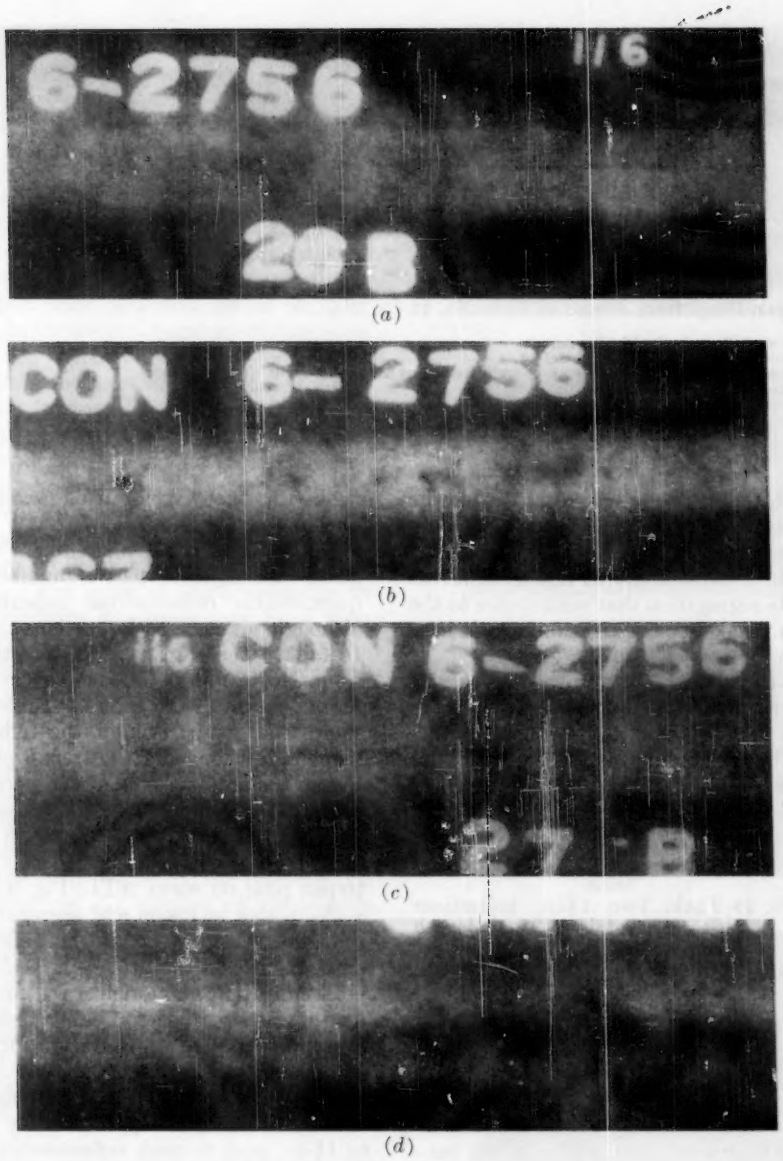


Fig. 5.—Radiographs of Seams in Tank No. 39 (×⅔).

(*a*) Seam 26B—Radiograph showing lack of penetration. A maximum reflectoscope indication of 1 in. was given along this weld.
(*b*) Seam 23B—Radiograph showing slag inclusions. A maximum reflectoscope indication of 1¼ in. was given along this weld.
(*c*) Seam 27B—Radiograph showing slag inclusions. A reflectoscope spot indication of 1 in. was given along this weld.
(*d*) Seam 56TL—Radiograph showing porosity and no indication of cracks. A maximum reflectoscope indication of 1¼ in. was given along this weld.

A high reflectoscope spot indication of 2½ in. was given on seam 3T, Fig. 4. With the exception of porosity, there was no evidence of any defect at this location. It is probable that the high reflectoscope indication was due to a "hidden" defect or a sharp weld bead. The radiograph for seam 3T is not shown in Fig. 5 because there were no defects shown in the radiograph.

No. 39 tank was returned to service after the door sheet cut out for X-ray equipment access was replaced and the trepan plug cutouts were repaired.

The reflectoscope data on No. 40 tank included only two spot indications exceeding 1 in. peak-to-peak. From the comparison of the reflectoscope data on No. 39 tank, it was concluded that the seam welds of No. 40 tank are of better quality than those of No. 39 tank and are free from major defects. No. 40 tank was not removed from service.

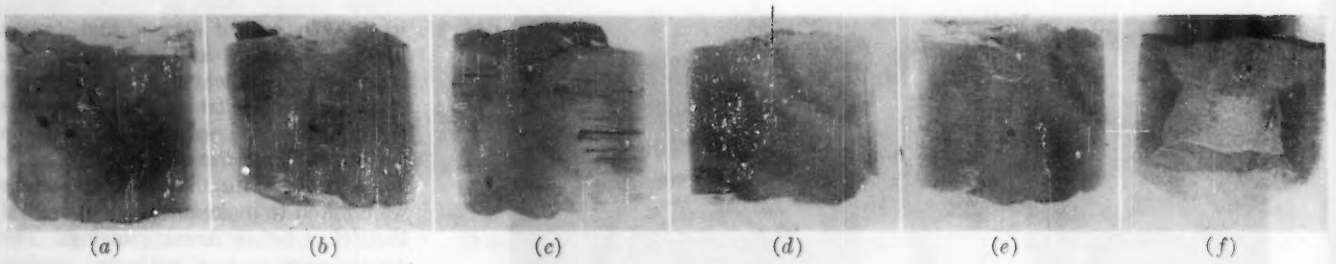
Inspection of Spherical Tanks Nos. 16, 17, 18, 19, 20

The reflectoscope showed a number of continuous 1½, 2, and 3-in. indications on the first circular seam below the equator of No. 16 tank, while the continuous indication on the other seams, with the exception of one vertical seam, was a maximum of 1 in. with some 1½-in. spot indications. No. 16 tank was taken out of service and trepan plugs were taken at locations of high reflectoscope indications. During the investigation of trepan plugs, it was determined that a serious lack of fusion defect existed in the questionable circular seam. A number of radiographs were taken to make a definite record of the defect before Arcair gouging. The Arcair gouging was witnessed and a record was kept as to the extent of the defects. A number of additional locations were checked to be sure that the serious defects were removed. The comparison of the Arcair gougings, reflectoscope indications, radiographs, and trepan plugs is shown in Table II. Figures 6 and 7 show the worst trepan plugs and the radiographs of the serious defects.

In general, the serious defect was located by the reflectoscope. At seam 4TR the original reflectoscope data did not give an indication of a defect, although a careful recheck at this location showed a 1½-in. peak-to-peak indication. The original reflectoscope data indicated a maximum of 2-in. peak-to-peak at the first juncture, seam 20BL, to the right of seam 4TR. Arcair gouging showed that the ½-in. lack of fusion defect was present in the circular seam from vertical seam 4T to vertical seam 20B. To the left of seam 4T the Arcair gouging showed no defects in the circular seam until the first juncture of vertical seam 21B. From seam 21B to and beyond vertical seam 5T for a total distance of 5 ft 2 in., the Arcair gouging showed a ¼ to ½-in. lack of fusion defect. The original reflectoscope data indicated a maximum of 1½-in. peak-to-peak at seam 21BR and a maximum of 3 in. at seam 5TL. Although the lack of penetration defect at seam 5TL is not definitely shown in Fig. 6, it is probable that the plug was cut in a good section of the weld. The lack of fusion defect is intermittent to a certain extent, and this is one of the reasons that such a large defect did not result in failure of the sphere.

In Fig. 7, two radiographs of seam 21BL are shown. It is quite evident that when the radiograph is taken at an angle such that the rays are parallel to the defect, a much more definite indication of the defect is shown. Even on the defects shown by the radiographs for seams 20BL and 4TR, the defect is not outstanding. Particularly on seam 20BL the defect could be interpreted as a bead shadow rather than a lack of fusion defect.

The lack of fusion defect was found at a number of places on the questionable circular seam. These defects were mostly about ⅛ in. deep and the maximum length was 6 in. as determined by the



(a) (b) (c) (d) (e) (f)

Fig. 6.—Trepan Plugs from Seams in Tank No. 16 (× 1⅛).

(a) Seam 4TR—Trepan plug showing ⅞-in. lack of fusion defect.
(b) Seam 20BL—Trepan plug showing ½-in. lack of fusion defect.
(c) Seam 5 TL—Trepan plug showing plate segregations and small inclusions along the right line of fusion.
(d) Seam 23BL—Trepan plug showing a plate segregation.
(e) Seam 17BL—Trepan plug showing ⅛-in. lack of fusion defect.
(f) Seam 23B—Trepan plug showing ¼-in. crack in weld.

Arcair gouging. On seam 17BL, Fig. 6, the trepan plug shows this defect. Seam 17BL is approximately 20 ft from the end of the serious defect.

At seam 15T a T-crack was found at the junction. The reflectoscope indication was 1½-in. peak-to-peak at this juncture.

The most serious indication on any vertical seam was the 2-in. peak-to-peak indication on seam 23B. The trepan plug is shown in Fig. 6 and the ¼-in. crack was 6 in. long according to the Arcair gouging observations.

The three slag inclusions shown by the radiographs were not serious. The maximum reflectoscope indications for these defects were 1-in. peak-to-peak.

A few other locations around the questionable circular seam were Arcair gouged to determine if any similar defects were present. A total of six locations were checked and no defects were found. The reflectoscope indications at these locations varied from 1 to 2-in. maximum peak-to-peak. There were some segregations in the plate, and these were probably the cause for some of the high reflectoscope indications where no defects existed. The trepan plug from seam 23BL, Fig. 6, shows a plate segregation. Also, seam 5TL, Fig. 6, shows plate segregation that contributes to the 3-in. peak-to-peak reflectoscope indication.

No. 16 tank was returned to service after repairing all Arcair gouged areas and trepan plug cutouts.

The reflectoscope data exceeding 1-in. peak-to-peak on Nos. 17, 18, and 19 tanks were as follows:

No. 17 Tank..	Two 1½-in. spot indications
No. 18 Tank..	Two 1½-in. indications totaling 12 in. in length One 2-in. spot indication
No. 19 Tank..	One 1½-in. indication 4 in. long Three 1½-in. spot indications Two 2-in. spot indications

Since there were only a few short indications that were questionable, it was concluded that Nos. 17, 18, and 19 tanks had satisfactory welded seams and these tanks were not taken out of service for any further checking.

On No. 20 tank the first circular seam below the equator had a number of questionable reflectoscope indications, although not as many indications as No. 16 tank. Ten trepan plugs were taken from No. 20 tank and no extremely serious defects were found. Table III shows the comparison of the reflectoscope indications and the trepan plugs. Figure 8 shows six of the worst trepan plugs. In general, the reflectoscope agrees with the defects found in the trepan plugs except for seam 16TL. The trepan plug on seam 16TL, Fig. 8, has a $\frac{3}{16}$-in. slag inclusion and segregations that should have given a higher reflectoscope indication than the ½-in. peak-to-peak indication. This defect was missed by the reflectoscope, probably because of improper surface preparation for the searching unit.

It would be expected that the slag inclusions would give approximately a 1 to 1½-in. peak-to-peak reflectoscope indication. The higher indications shown in Table III are probably due to the plate segregations. No. 20 tank was returned to service with no repairs other than to weld up the trepan plug

TABLE II.—SUMMARY OF NO. 16 TANK DATA SHOWING COMPARISON OF ARCAIR GOUGING AT 26 LOCATIONS, REFLECTOSCOPE INDICATIONS, RADIOGRAPHS, AND TREPAN PLUGS.

Locations	Arcair Gouging	Maximum Peak-to-Peak Reflectoscope Indications	Radiograph Shows	Trepan Plug Shows
2....	½-in. lack of fusion defects connecting for 3 ft. 6 in. total length	1 is 1½ in. 1 is 2 in.	Lack of fusion (Fig. 7) Lack of fusion (Fig. 7)	Seam 4TR (Fig. 6) ⅞-in. lack of fusion Seam 20BL (Fig. 6) ½-in. lack of fusion
3....	¼ in. to ½-in. lack of fusion defects connecting for 5 ft 2 in. total length	2 are 1½ in. with 2 in. spot 1 is 3 in.	Lack of fusion when taken at proper angle (Fig. 7)	Seam 5TL (Fig. 6) Segregations but no definite lack of fusion
10....	⅜-in. lack of fusion defects; maximum length of 6 in. Evidently continuation of serious defects above	1 is 1 in. 1 is 1½ in. 1 is 3 in. 7 are spots (6 are 1 in., 1 is 3 in.)		Seam 23BL (Fig. 6) Plate segregation Seam 17BL (Fig. 6) ⅛-in. lack of fusion
1....	½-in. crack	1 is 1½ in.	"T" crack at junction	
1....	¼-in. crack 6 in. long	1 is 2 in.		Seam 23B (Fig. 6) ¼-in. deep crack
3....	Slag inclusions	3 are 1 in.	Slag inclusions	
6....	No defects	1 is 1 in. 4 are 1½ in. 1 is 2 in.	1 has no defect	

TABLE III.—SUMMARY OF NO. 20 TANK DATA SHOWING COMPARISON OF REFLECTOSCOPE INDICATIONS AND TEN TREPAN PLUGS.

Maximum Peak-to-Peak Reflectoscope Indications	Trepan Plug Shows
2½ in.....	Seam 7TL (Fig. 8) ⅛-in. slag inclusion, porosity, and plate segregation
2 in.....	Seam 21BL (Fig. 8) ⅛-in. slag inclusion and porosity
1½–2 in....	Seam 10TR (Fig. 8) ⅛-in. lack of fusion defect
½ in.....	Seam 16TL (Fig. 8) ⅛-in. slag inclusion
½ in.....	Seam 23BL (Fig. 8) General porosity
2½-in. spot..	Seam 1T (Fig. 8) Two ⅛-in. slag inclusions
2-in. spot....	Seam 20BR Small porosity
2-in. spot....	Seam 31BR Small slag inclusion and porosity
2-in. spot....	Seam 14TL Plate segregation and high porosity
2-in. spot....	Seam 19BL General porosity

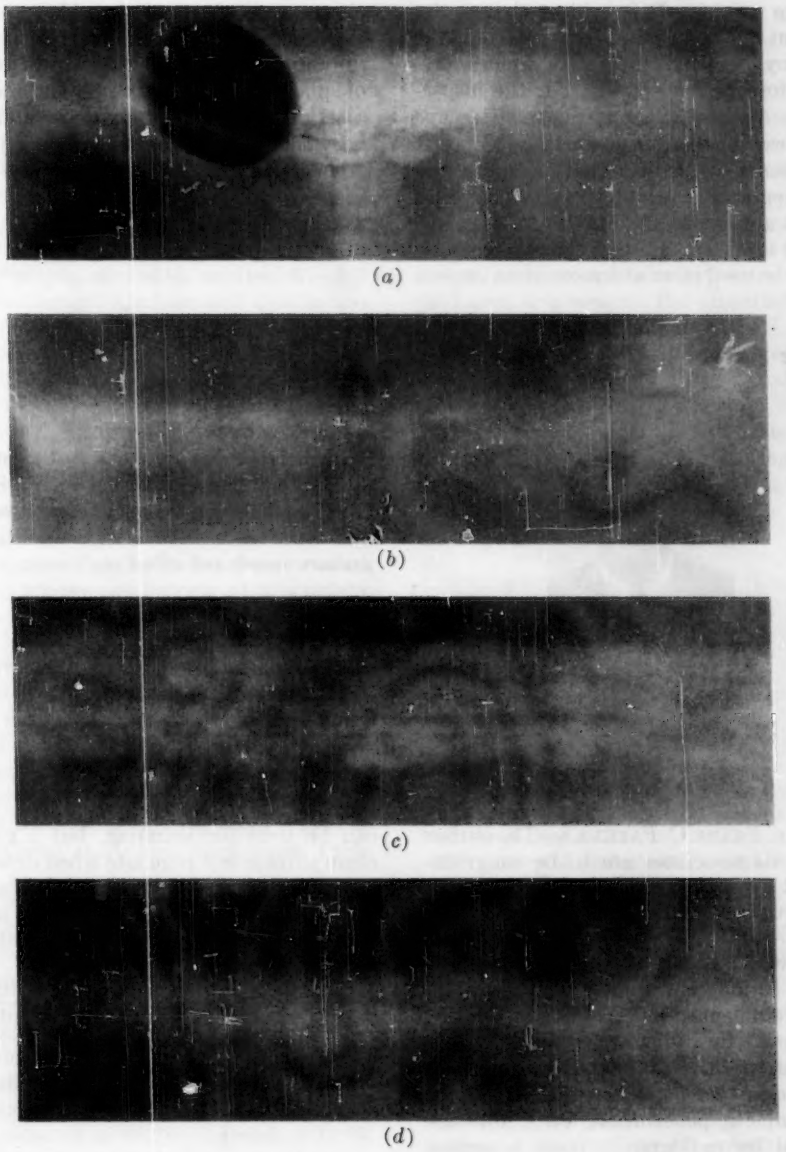
holes as the defects found were considered undesirable but not extremely serious.

Summary of Inspections

From the above summaries, it is evident that the most serious defect found by our inspection was the $\frac{1}{2}$-in. lack of fusion defect for 3 ft 6 in. and the $\frac{1}{4}$ to $\frac{1}{2}$-in. lack of fusion defect for 5 ft 2 in. in the lower circumferential seam on No. 16 tank. Actually, the lack of fusion defect on this seam was intermittently present a number of places around the circumference but to a much lesser degree. The reflectoscope indications showed that this was the most critical seam. Even on this seam the reflectoscope gave some indications where no definite weld defects could be found, but some of these were due to segregations and some may have been due to the weld bead reflecting the sonic waves in such a way that a defect appeared to be present. As we gain more experience with the reflectoscope, we shall be able to tell more definitely whether an indication is a defect or segregations in the steel.

On the average, we believe we obtained a good indication of the quality of the seam welds by the reflectoscope indications. A number of undesirable defects were found other than the serious defect in No. 16 tank, and the reflectoscope was fairly consistent in indicating such defects even though they were not considered serious enough for removal and welding. In some cases we found defects that would be rather difficult to show with normal radiographic techniques.

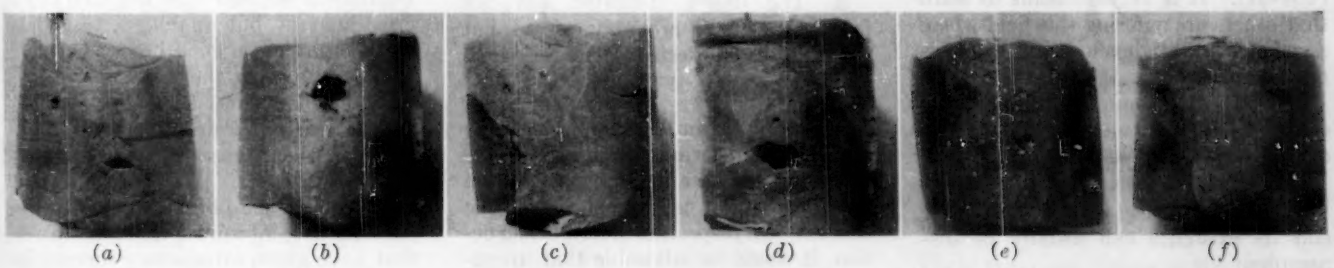
From an economy standpoint, the reflectoscope method of inspection was considerably cheaper than the radiograph method. Although Nos. 16, 20, and 39 tanks were removed from service for further inspection after reflectoscope data were taken, the seam welds of Nos. 17, 18, 19, and 40 tanks were evaluated by an exclusive reflectoscope inspection and these spheres were not removed



(a) (b) (c) (d)

Fig. 7.—Radiographs of Seams in Tank No. 16 ($\times$ $\frac{5}{8}$).

(a) Seam 4TL and 4TR—Radiograph showing trepan plug hole and lack of fusion defect at junction. A reflectoscope indication of 1½ in. was given along this weld.
(b) Seam 20BL—Radiograph showing trepan plug hole and lack of fusion shadow along lower bevel. A reflectoscope indication of 2 in. was given along this weld.
(c) Seam 21BL—Radiograph taken at an angle parallel to the lower bevel and showing a definite lack of fusion defect. A reflectoscope indication of 1½ in. was given along this weld.
(d) Seam 21BL—Radiograph taken from a normal position and showing a less definite lack of fusion defect.



(a) (b) (c) (d) (e) (f)

Fig. 8.—Trepan Plugs from Seams in Tank No. 20 ($\times$ 1⅛).

(a) Seam 7TL—Trepan plug showing slag inclusions and plate segrations.
(b) Seam 21BL—Trepan plug showing slag inclusions.
(c) Seam 10TR—Trepan plug showing $\frac{1}{16}$-in. lack of fusion defect.
(d) Seam 16TL—Trepan plug showing slag inclusions and plate segregations.
(e) Seam 23BL—Trepan plug showing porosity.
(f) Seam 1T—Trepan plug showing slag inclusions and plate segregations.

from service. It is evident that equipment down-time costs can be avoided in many cases by utilizing an exclusive reflectoscope inspection. For the inspection of these spheres, the reflectoscope inspection cost approximately $3 per ft of seam weld inspected, whereas the radiograph inspection of No. 39 tank cost approximately $14 per ft.

It is our opinion that the reflectoscope will be used more and more as an inspection tool for inspecting welded seams. We need a great deal more experience to fully evaluate the tool. On this group of spheres, it was responsible for finding a serious defect in one sphere, and we are assured that the seam welds on the other six spheres do not have any extremely serious defects.

Conclusions

1. A serious defect in one of the seven spheres was indicated by the reflectoscope indications.
2. The general quality of the seam welds of a large diameter sphere can be determined by an exclusive reflectoscope inspection.
3. If the reflectoscope inspection indicates a poor quality weld, it is advisable to make further investigation by radiographic inspection or by sectioning methods.

The Author . . .

LEVI TARR has spent the past eighteen years doing inspection work for Phillips Petroleum Co., and is now Chief Inspector, Test Division of the Engineering Department. Most of the inspection work has been on fabrication of welded structures, such as refinery pressure vessels and allied equipment.

DISCUSSION

Mr. Frank C. Parker.[1]—The author and his associates are to be congratulated for making such a careful and intensive study. Their efforts were well rewarded. It is difficult to pioneer in this work, as ultrasonics reveal defects, both serious and minor, which exist in all weldments (and plate) and are not disclosed by radiography or any other non-destructive method of examination. The existence of cracks, lack of fusion, incomplete penetration, etc., not disclosed by radiography poses a serious problem in regard to a safe level of acceptance. Eventually, maximum acceptable lengths and depths of cracks and other defects must be specified for ultrasonic examinations. This is much more difficult than the present code statements to the effect that any cracks or zones of incomplete penetration shown by radiography are unacceptable (UW-51). It is very pleasant to learn that others are entering this field where a great deal of development work is needed to be done.

The following comments are based on our experiences in ultrasonic weldment examinations:

1. The weld bead gives little trouble and its existence can usually be disregarded.
2. A relatively poor contact surface can be used for scanning, but a good clean surface is a requisite when defects are to be measured. A 4-in. sanded band parallel to the weldment is rather narrow for plate and welds of approximately 1 in. in thickness.
3. The following have been omitted from the paper, so the defects cannot be accurately evaluated:
   (*a*) Instrument settings and data.
   (*b*) Length or width of $\frac{5}{16}$-in. vertical defect.
   (*c*) Depth and bottom shape of drilled hole.
   (*d*) Area from which maximum reflection is obtained.
4. It is stated that the trepans from No. 20 tank contained no critical defects, yet the trepans in Fig. 8 show lack of fusion, incomplete penetration, and porosity or inclusions.
5. The defect indicated but not found in seam 3T probably existed, but these are easily destroyed or missed in sectioning.

Mr. Levi Tarr (*author*).—Generally speaking the normal weld bead gives little trouble. In a few cases we felt the weld bead might have been giving some trouble. On inspection of new construction, it would be advisable that irregular weld beads be smoothed by grinding or chipping.

It would have been desirable to use a power sander for the preparation of the contact surface, but due to safety reasons, a power sander could not be used while the spheres were in service. We found the 4-in. band on each side of the weld was generally sufficient for locating any defect in the weld. In a few cases we went beyond the 4-in. band.

No attempt was made to keep a record of the instrument settings. The $\frac{7}{8}$-in. thick test plate used was 4 in. wide and 16 in. long with a double butt weld in the center of the plate. This weld had a $\frac{5}{16}$-in. lack of penetration defect in the bottom part of the weld for the 4-in. width of the test plate. The $\frac{1}{8}$-in. hole was drilled in the edge of the test plate for a depth of 2 in. This $\frac{1}{8}$-in. hole was located about $\frac{7}{16}$ in. from the top surface of the plate and about 4 in. from the weld and parallel to the weld. The test plate was used to calibrate the instrument several times each day. The instrument settings were not changed a great amount, but we felt the test plate method gave us a good practical meaning of calibrating the instrument.

The trepan plugs from No. 20 tank certainly are not desirable, and we would consider them unsatisfactory on any new construction. We have shown the worst side of the plug, and the slag inclusions are intermittent. On vessels that have given satisfactory service for a number of years, we do not feel these defects are extremely serious.

It is possible that there could be a defect at 3T on tank No. 39 that is not shown by the trepan plug.

[1] Test and Inspection Division, Union Carbide and Carbon Corp., South Charleston, W. Va.

Discussion of Paper on Analytical Study of the Die-Casting Process[1]

MR. EDWARD JACOBI.[2]—The application of the formulas to the calculation of problems in die-casting equipment design or operation requires knowledge of the conditions and limitations under which the formulas are valid. This necessitates reference to the dissertation from which the paper is condensed.[3]

Statements are made, at various points in the mathematical development, that terms may be dropped, that variables may be taken constant for convenience in integration, and the like. These statements are unsupported by experimental verification or other justification. Table II gives figures of results and of optimum venting, but no evidence is adduced to show that these numerical values are actually found in practice.

The concept of optimum venting implies that vents, larger as well as smaller than an optimum area, will produce poorer (more porous) castings. This does not agree with practical experience. Vents are generally made as large as they can be without allowing metal to spurt from the dies. Designs have been published that show areas of vent and gate comparable to the casting sectional area. Such proportions attempt to displace the air from the mold cavity into an overflow chamber to collect the unsound metal. The vent resistance to the final compacting pressure is less important in such designs.

The calculations of optimum venting in the dissertation should have further study by reason of arbitrary assumptions as to a fixed time at which the vents seal off. The time of sealing would appear to depend greatly on mold and metal temperatures although these are not considered in the formulas. Other assumptions about changes in vent area by progress of metal freezing and other factors mentioned in the course of the development of the theory, leave the accuracy of calculated optimum venting and its effect on blowholes in doubt. Moreover, the absolute air pressure, which is carried as a variable into the calculations, is later taken as an arbitrary 500 psi constant. Apparently, this is done to avoid complications in the mathematics.

In the paper[4] it is stated that the slowest gooseneck machine fills the die 1.35 times faster than the fastest cold chamber machine investigated. Results of measurements bearing on this assertion ought to be reported, as this is surprising in view of the available energy in the plunger machine and that in the air machine. Practical die casters also have questioned this.

The calculated figures indicate that the steady state filling time is longer than the filling time calculated by the transient state formula. The calculation of the transient state includes calculation of the time of accelerating from rest, the stream of metal, and the plunger. The steady state assumes that these masses are moving at a constant velocity through the stroke. As the acceleration of the moving masses consumes time, the simplifying assumption of steady state flow may be expected to produce a smaller calculated elapsed time for the filling of the die than the transient state. This appears to prove that the formulas are not correct, or that they are invalid in some ranges of numerical conditions, such as in Table II.

The paper represents considerable work and time. It reflects credit for its erudition and advancement beyond the present state of the art. The applicability of its formulas should be reviewed by the careful checking of its mathematical processes. Also, results computed by these formulas should be checked by the measurements that were found in the research of W. Babington and D. H. Kleppinger.[5]

[4] P. 36 (TP 126).

[5] "Aluminum Die Castings—The Effect of Process Variables on Their Properties," *Proceedings*, Am. Soc. Testing Mats., Vol. 51, p. 169 (1951). Discussion, Vol. 52, p. 199 (1952).

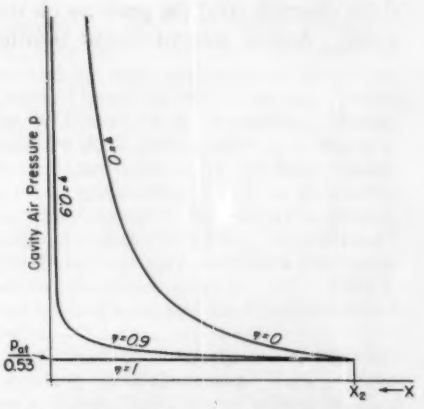


Fig. 12.—Correlation of Metal Position and Cavity Air Pressure.

MR. BRUNO SACHS (*author*).—Every statement in the dissertation claiming that certain terms are insignificant and may be dropped is accompanied by an indication of the error. The compounded effect of these simplications, for instance on the metal velocity, was analyzed and is given in the dissertation as being less than 0.1 per cent.

Nowhere, neither for convenience nor for any other reason, are variables taken as constants. Mr. Jacobi may have reference to the venting factor n or to the mean static force B acting on the piston or on the metal in the gooseneck. The general expression for the venting factor is

$$n = \frac{0.53 f_v C^* R \sqrt{T_1}}{f_0 w_0} \left(\frac{p + p_{at}}{p_{at}} \right)^{1/7}$$

where:

f_v = effective vent area at plunger or metal position x and time t,
w_0 = plunger or metal velocity at position x and time t,
p = air pressure in die cavity at plunger or metal position x and time t,
f_0 = area of plunger or gooseneck,
C^* = coefficient of discharge,
R = gas constant,
T_1 = absolute temperature of air for plunger or metal position x_1, and
p_{at} = atmospheric pressure.

This venting factor n contains the three variables f_v, w_0 and p. During the actual cavity filling period, the pressure p increases while f_v and w_0 decrease. A proof for the reasonableness of the introduction of the venting factor is given in the dissertation and follows mainly from the combination of the equation for the venting factor n and the air pressure in the die cavity p. The air pressure in the die cavity is:

$$p = p_{at} \left[\frac{1}{0.53} \left(\frac{x_3 - x_2}{x_3 - x} \right)^{7/5\,(1-n)} - 1 \right]$$

or

$$\frac{p + p_{at}}{p_{at}} = \frac{1}{0.53} \left(\frac{x_3 - x_2}{x_3 - x} \right)^{7/5\,(1-n)}.$$

With $n = 0$, the pressure p in the cavity follows the adiabatic; with $n = 1$, it remains constant and equals the critical pressure $\frac{p_{at}}{0.53}$, see Fig. 12. These two cases represent the two conceivable extremes; namely, zero venting with all the air trapped and infinite venting with no air trapped. The pressure course for any other condition must lie between these two extremes.

[1] Bruno Sachs, "An Analytical Study of the Die-Casting Process," ASTM BULLETIN, No. 192, September, 1953, p. 27 (TP 117).

[2] Chief Engineer, Briggs & Stratton Corp., Milwaukee, Wis.

[3] The paper is an abridged presentation of a dissertation, sponsored by the Mechanical Engineering Department of Columbia University and accepted by the Faculty of Pure Science of Columbia University in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

For the purpose of calculating the filling time, the varying force, acting upon the piston or upon the metal in the gooseneck, was replaced by a constant force B of such a magnitude that its work performed during the cavity filling period equals the work of the variable force. A separate integration was carried out for this purpose. Such a procedure is perfectly legitimate and accepted in applied mechanics. The resulting theoretical error for the conditions as they exist in die casting is less than 1 per cent.

Now to the concept of optimum venting. The die-casting operaton—shot—takes place in a transient state condition. An analysis of these conditions is quite involved. An analysis under steady state conditions is simpler and helpful and permits certain conclusions as to the influence of the various machine and metal system characteristics upon the metal velocity, pressure, and venting condition. Therefore, the dissertation presented in its first part an analysis of steady state conditions and in its second part the analysis of transient conditions.

The steady state is defined by the only criterion that the metal velocity is constant. During the actual die-filling period the four systems, drive system, return system, metal system, and air system are coupled and act simultaneously, and the condition of constant metal velocity must be imposed upon them. It is obvious that we have in this case an idealized picture which does not represent reality; on the other hand, it is susceptible to an exact and relatively simple analysis. The analysis shows clearly that the rate of air flow (air weight per second) through the vent slots is an optimum for a certain fixed value of the vent area f_{v0}. A larger, as well as a smaller vent area, will reduce the rate of air flow.

In actual die casting, as represented by the analysis of the transient condition, a larger than the optimum vent area will not improve, nor will it make

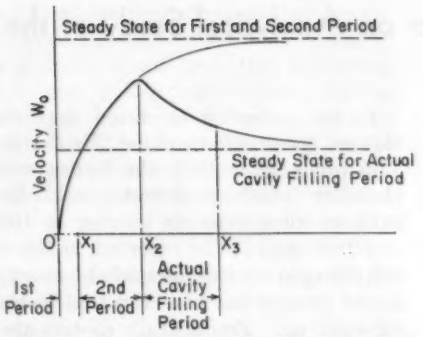


Fig. 13.—Correlation of Metal Position and Velocity.

worse, the over-all porosity of the casting, except possibly at points of otherwise locally trapped air. For this reason, the term "optimum venting" was retained for steady as well as for transient state throughout the whole study. In this sense, the formula for the optimum total vent area in the paper represents the minimum vent area required to obtain optimum venting condition.

Mr. Jacobi refers to arbitrary assumptions as to a fixed time at which the vents seal off. No such assumptons were made. As I mentioned before, the vent area f_v was considered as being a variable, decreasing from the original total vent area in the die, f_{v0}, to zero at the end of the shot. Metal and mold temperatures are considered in the formula for venting factor.

Mr. Jacobi states further that the absolute air pressure, which is carried as a variable into the calculations, is later taken as an arbitrary 500 psi constant and that this, apparently, is done to avoid complications in the mathematics. This is not at all so and I cannot see how, or from where, Mr. Jacobi got this idea.

I am not surprised that practical die casters (and I am one of them) find it hard to believe that the slowest gooseneck machine with a static pressure of only 500 psi fills the die 1.35 times as quickly as the fastest cold-chamber machine exerting 8000 psi pressure on the metal. Actual measurements bearing on this conclusion have not been made as yet and, therefore, at least at this time, analytical calculations and a detailed and thorough interpretation of the resulting equations are the only means to shed light on this situation.

Mr. Jacobi expects the simplifying assumption of steady state flow to produce a smaller calculated elapsed time for the filling of the die than the transient. The calculated values presented in Table II show just the opposite, and this appears to prove to Mr. Jacobi that the equations are not correct or that they are invalid in some ranges of numerical conditions, such as in Table II. Mr. Jacobi obviously overlooks entirely the fact that during the first and second periods the steady state velocity is determined only by the drive and return system. This steady state velocity is much greater than the steady state velocity during the actual die-filling period which is determined by the drive, return, metal, and air system (see the accompanying Fig. 13).

Mr. Jacobi suggested that the results completed by the formulas of this study should be checked by the measurements that are found in the research of W. Babington and D. H. Kleppinger. This was done qualitatively.[6] A quantitative check could not be made because the Babington-Kleppinger experimental setup was not designed for this purpose and therefore not all the variables necessary for the calculations were recorded in the Babington-Kleppinger research. One of the purposes of the study presently under discussion was to provide the mathematical framework for a working theory on die casting, enumerating and coordinating the many variables in the process. Such a working theory is indispensable for the planning of experimental work and for the proper "design of the experiment" in order to check the theory and, beyond that, to be able to generalize experimentally gained knowledge and to extend it to various kinds and types of die casting machines and conditions.

[6] Discussion, *Proceedings*, Am. Soc. Testing Mats., Vol. 51, p. 193 (1951).

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

Joseph Abele, Senior Engineer, Philadelphia Electric Co., recently retired after nearly 39 years with the company. A member of the Society for many years, Mr. Abele had represented his company in various technical committees. He was especially interested in the work in Committee A-1 involving pipe and tubing and materials for high-temperature service.

Charles B. Baker, formerly Executive Vice-President, has succeeded **Blaine S. Smith,** retired, as President, Universal Atlas Cement Co., New York City. With the firm for more than 37 years, Mr. Smith continues as a consultant.

Milton R. Beasley, for the last three years associated with Central Commercial Co., Chicago, Ill., as Technical Assistant to the President, has been elected a Vice-President of the company (manufacturers of roofing granules). Mr. Beasley is a former member of the Research Committee of the Asphalt Roofing Industry Bureau.

Hugh F. Beeghly, Head of the Applied Science Section, Division of Metallurgical Research, Jones & Laughlin Steel Corp., Pittsburgh, Pa., has been appointed to the Advisory Board of *Analytical Chemistry.*

W. H. C. Berg has been made Director of Standards and Research for Hanson-Whitney Division, Whitney Chain Co., Hartford, Conn.

Earle S. Bidgood, formerly Chief Metallurgist, Remington Rand, Inc., Laboratory of Advance Research, South Norwalk, Conn., is now Chief Chemist, Stamford Div., The Allen D. Cardwell Manufacturing Corp., Stamford, Conn.

Franklin C. Burk, Assistant Director of Applied Research, The Atlantic Refining Co., Philadelphia, Pa., was honored recently by the Society of Automotive Engineers for his long service and contributions to the society and to automotive engineering. In a ceremony held at the Philadelphia Engineers' Club Mr. Burk received a plaque commemorating 25 years of active work in his profession and with SAE. In ASTM he has rendered valued service in Committee D-2 on Petroleum Products and Lubricants, currently heading Research Division I on Combustion Characteristics.

E. E. Chapman, for many years Engineer of Tests, The Atchison, Topeka and Santa Fe Railway System, Chicago, Ill., and more recently Mechanical Assistant to the Assistant to the Vice-President, has retired. A member of ASTM since 1921, Mr. Chapman has served through the years on many of the technical committees, especially the ferrous groups, also Committees D-2 on Petroleum Products, and D-11 on Rubber. He has been active in the Chicago District Council since 1940.

Charles J. Code, formerly Engineer of Tests, Maintenance of Way, The Pennsylvania Railroad Co., Philadelphia, is now Assistant Chief Engineer—Engineer of Tests.

Coverdale & Colpitts, Consulting Engineers, New York City, recently celebrated the fiftieth anniversary of the founding of the firm. Messrs **R. F. Passano** and **R. N. Repp** of this organization have been ASTM affiliates for many years.

Ernest W. Dean (retired Director, Standard Inspection Lab., Standard Oil Development Co., New York City) has been elected to honorary membership in ASTM Committee D-2 on Petroleum Products and Lubricants in recognition of his major contributions toward the advancement of test methods and specifications developed through the activities of this group.

Ray P. Dinsmore, Vice-President in Charge of Research and Development, Goodyear Tire & Rubber Co., Akron, Ohio, has been elected a director of the American Institute of Chemical Engineers.

Charles L. Fleming, Jr., formerly Associate Director, Research Division, Standard Oil Development Co., Linden, N. J., has been promoted to Director of the Division.

Curry E. Ford, Assistant Manager, Chemical and Metallurgical Dept., National Carbon Div., Union Carbide and Carbon Corp., and **G. M. Juredine,** Research Chemist, Harshaw Chemical Co., were among four Cleveland chemists honored by their colleagues at the Fifth Annual Dinner of the Chemical Profession in Cleveland in December. Recognized for distinguished service to the profession, they were cited for their "unselfish and persevering efforts in promoting the effectiveness of the one or more professional societies which they have served." The dinner was sponsored by a joint committee representing ACS, AIC, AIChE, Alpha Chi Sigma, and the Electrochemical Society.

John Griffen, formerly with McNally Pittsburg Manufacturing Corp., Pittsburg, Kans., has opened offices as Coal and Coke Consultant in Pittsburgh, Pa.

Bertrand W. Hayward, Director of the Philadelphia Textile Institute, has been elected President of the National Council of Textile Education.

Harold O. Hill, Assistant Chief Engineer of Fabricated Steel Construction at Bethlehem Steel Co., Bethlehem, Pa., received the Miller Medal Award at the 34th Annual Meeting of the American Welding Society in late '53.

Leon Kapelsohn, formerly associated with Chemical Specialties Co.; Dro, Inc., New York City, is now General Manager, Kopp Scientific, Inc., Springfield, Mass.

H. R. Lewis, Chief Metallurgist of Ohio Seamless Tube Division of Copperweld Steel Co., Shelby, Ohio, culminated 45 successful years with the steel industry on January 1, 1954. He had been associated with Ohio Seamless Tube Co. since April, 1919.

Herman F. Mark, Director of the Polymer Research Institute, Brooklyn Polytechnic Institute, was recently appointed to the Advisory Board of *Chemical and Engineering News.*

R. G. May has been named Vice-President, Operations and Maintenance Dept., Association of American Railroads, Washington, D. C., succeeding J. H. Aydelott, retired.

The National Slag Association, Washington, D. C., has announced change in address. After being in the Warner Building for some 20 years the NSA headquarters office has moved to the new Perpetual Building (Room 613) Washington 4. **E. W. Bauman,** Managing Director, invites friends to "drop by and see the new setup when in town."

E. Burnley Powell retired from Stone & Webster Engineering Corp., Boston, Mass. He is continuing his ASTM affiliation and membership on several of the technical groups. Mr. Powell resides in Brookline, Mass.

E. R. Queer, Director of the Department of Engineering Research, Pennsylvania State University, State College, Pa., has been elected Treasurer of The American Society of Heating and Ventilating Engineers. Professor Queer is Chairman of ASTM Committee C-16 on Thermal Insulating Materials.

Sidney Rolle has retired as Assistant Manager, The Scomet Co., New York City. Mr. Rolle has established himself as Consulting Metallurgical Engineer and will continue his ASTM affiliation through personal membership. He has been active in several of the non-ferrous technical committees.

John H. Romann, until recently Vice-President and General Manager, The Prescott Co., Menominee, Mich., has been elected President of his company, succeeding the late James A. Hamilton.

T. A. Rourke, formerly Plant Engineer, Dominion Lime, Ltd., Lime Ridge, is now with International Lime and Stone Corp., Chazy, N. Y., in the capacity of Vice-President and General Manager.

William H. Rowand, Vice-President, The Babcock & Wilcox Co., New York City, was awarded the Newcomen Medal by The Franklin Institute of Pennsylvania "for achievement in steam," this medal

(*Continued on page 66*)

(*Continued from page 65*)

having been given only three times before in the history of the U. S. branch of the Newcomen Society. Mr. Rowand's foremost contribution to steam progress, which led to his nomination, was his invention in 1936 of the cyclone steam separator.

Sargent & Lundy, Consulting Engineers, Chicago, Ill., announced the retirement of **Ludwig Skog,** Senior Partner, as of December 31, 1953. Born and educated in Norway, Mr. Skog received his Mechanical Engineer degree from Trondheim Polytechnic Institute in 1909, and joined Sargent & Lundy in 1910, becoming Senior Partner in 1947. Widely known in engineering circles, he is considered one of the most outstanding electric power station design engineers in the country. **Alf Kolflat,** who joined the firm of Sargent & Lundy in 1925, has been appointed Senior Partner to succeed Mr. Skog.

Elmer F. Schmidt, Vice-President and Director of Lone Star Gas Co., Dallas, Tex., has been elected an Executive Senior Vice-President of his company. Mr. Schmidt is active in Committee D-2 on Petroleum Products and Lubricants, and is a member of the recently organized ASTM Southwest District Council.

Bourdon F. Scribner, Chief of the Spectrochemistry Section, National Bureau of Standards, is the new editor of *The Capital Chemist,* publication of the Washington Section of the American Chemical Society.

Jacob R. Shank, Assistant Director since 1938 of the Ohio State University's Engineering Experiment Station, Columbus, will return in April, 1954, to full-time teaching as Professor in the Department of Civil Engineering of the College of Engineering. He has asked to be relieved as the administrative head of the Experiment Station, to devote his full time to the professorship. **Robert S. Green,** Chairman of the Department of Welding Engineering, has been named Executive Director of the Experiment Station, remaining as department head and part-time professor. He has been a member of the Ohio State engineering teaching staff since 1947.

J. Paul Sherwin has retired as Chief Inspector of the Homestead Steel Works, U. S. Steel Corp., Munhall, Pa. He may be addressed at 325 Mercer St., Munhall.

Alexander C. Speer, formerly with Johns-Manville Corp., New York City, is now with the Western Electric Co., S. Kearny, N. J., in the capacity of Mechanical Engineer.

E. Sweetland, Chief Chemist, Pennsylvania Salt Mfg. Co., Wyandotte, Mich., has retired. Mr. Sweetland had represented his company for many years in the Society and on Committee E-2 on Emission Spectroscopy.

Henry L. Taylor, formerly with Thomas B. Bourne Associates as Chief, Specifications, has established his own office as Construction Specifications Consultant in Arlington, Va.

James L. Thomas, former Chief of the Resistance Measurement Section of the National Bureau of Standards, has been appointed Chief of the newly organized Resistance and Reactance Section of the Bureau's Electricity Division, concerned with precision electrical resistance, capacitance, and inductance measurements. With the Bureau since 1927, Dr. Thomas has made many contributions to the field of electrical measurements.

John C. Thornton, Detroit Edison construction department architect and widely-known amateur lapidary, retired in December after nearly 38 years of service. He had been active in the design of most of the company's major buildings, and in 1953 in recognition of his research on improvement of the bonding properties of mortar in masonry construction he received the Alex Dow Award for extraordinary service to his company. His interest in the lapidary art—the cutting, polishing, and engraving of precious and semiprecious stones—is of long standing. His lapidary workshop, library, and mineral collection (some 3000 mineral and gem specimens) are at his home: 502 Laurel, Royal Oak, Mich.

Austin Tustin, distinguished British engineer and head of the Department of Electrical Engineering at the University of Birmingham, England, is occupying the Webster Chair of Electrical Engineering as a visiting professor at the Massachusetts Institute of Technology for the academic year 1953–1954.

Thomas H. Vaughn, formerly Vice-President, Research and Development, Wyandotte Chemicals Corp., Wyandotte, Mich., is now Vice-President, Research and Development, Colgate-Palmolive Co., Jersey City, N. J.

Harvey A. Wagner, until recently Assistant Chief, Engineering Department, Detroit Edison Co., Detroit, Mich., has been appointed an assistant manager of engineering in a regrouping of the company's engineering organization, with the official title of Director of Nuclear Power Development.

Perhaps **J. Paul Wilson,** Owner, Wilson Testing Laboratory, Clearwater, Fla., should have his "specifications and methods" for a happy retirement standardized. Mr. Wilson, prior to his retirement in 1951 from the Ford Applied Physics Laboratory in Detroit, "blueprinted his golden years" and is utilizing his experience in rubber and plastic testing in his own testing and weather exposure laboratory. For many years representative of the Ford Co. in ASTM Committee D-11 on Rubber and Rubber-Like Materials, Mr. Wilson now holds personal membership in the Society and on the Rubber Committee. **Don McCutcheon,** formerly with Ford, is also active in ASTM technical work, and a Past-Chairman of the Detroit District. He, too, is now in Florida (Madeira Beach) engaged as Consultant in Engineering-Physics.

Morton O. Withey, Emeritus Dean of the University of Wisconsin College of Engineering, has been elected an honorary member of the Engineers' Society of Milwaukee in recognition of distinguished service to the engineering profession. Affiliated with ASTM since 1907, and a Past-Director, Professor Withey has been very active in many phases of the Society's work, especially in Committee C-9 on Concrete where he was elected to honorary membership in 1950.

W. J. Youden, Statistician, National Bureau of Standards, Washington, D. C., will be a guest lecturer in a special program on statistics for research engineers, physicists, and chemists, sponsored by the Institute of Statistics of the University of North Carolina, March 24 to June 4.

Roy N. Young, Vice-President and Operating Manager, Lehigh Portland Cement Co., Allentown, Pa., has retired. Affiliated with ASTM since 1921, Mr. Young has been active in Committee C-1 on Cement for many years. He also has represented the Portland Cement Assn. since 1936 on ASA Sectional Committee A-1 on Specifications and Methods of Test for Hydraulic Cements.

Paul G. Agnew, Standardization Leader

PAUL G. AGNEW, one of the pioneer leaders in standardization in the United States, died at his home in New York January 8, at the age of 72.

Secretary of the American Standards Assn. until his retirement in December, 1947, he served 28 years in this capacity.

Known internationally for his leadership in promoting universally accepted standards, Dr. Agnew helped to lay the foundation of the International Federation of National Standardization Associations which was dissolved during World War II, and in 1946, he helped the present International Organization for Standardization (ISO).

A native of Michigan, Dr. Agnew taught physics in Michigan high schools and subsequently was a physicist for the Bureau of Standards, for 13 years. He had a leading part as a member of the Bureau's Electrical Instruments Section in developing methods and apparatus for alternating-current measurements. Some of his papers on instrument transformers were milestones on that subject.

WHAT'S NEW

In Petroleum Testing At Fisher Scientific?

You undoubtedly know that the American Society for Testing Materials has recently completed a thorough revision of the basic conversion tables used in the measurement of specific gravity, viscosity and other properties of petroleum products. This revision coincides with two activities now in progress at Fisher Scientific, which we believe will be important to oil chemists everywhere.

First, Fisher is completely redesigning its Fisher/Tag petroleum testing instruments, successors to the famous line manufactured by C. J. Tagliabue. These instruments will as always meet the specifications and perform the tests standardized by the ASTM.

Second, we are completely revising the *Fisher/Tag Manual for Inspectors of Petroleum,* the handy pocket reference on testing procedures for the oil industry. The present *Manual* became obsolete January 1 with the introduction of the new conversion tables and the revision of a number of important test procedures. With our modernization of the original Tagliabue instruments, this has made necessary the writing of a completely new *Manual.* It will outline procedures for the basic petroleum tests, in line with the revised ASTM methods and use of the improved Fisher/Tag instruments.

The new *Fisher/Tag Manual for Inspectors of Petroleum* (28th Edition) will be ready on or about April 1, 1954. Why not reserve your copies *now* so that you will have this valuable reference book in your hands as soon as possible?

FISHER SCIENTIFIC

America's Largest Manufacturer-Distributor of Laboratory Appliances and Reagent Chemicals

PITTSBURGH (19) 717 Forbes St. | NEW YORK (14) 635 Greenwich St. | ST. LOUIS (18) 2850 S. Jefferson Ave. | WASHINGTON 7722 Woodbury Dr. Silver Spring, Md. | MONTREAL (3) 904 St. James St. | TORONTO (8) 245 Carlaw Ave.

NEW MEMBERS...

The following 61 members were elected from January 1, 1954, to January 21, 1954, making the total membership 7582 . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first then Individuals

CHICAGO DISTRICT

Twin City Die Castings Co., Charles G. Adams, President and Treasurer, Talmage and Thirty-third Aves. S.E., Minneapolis 14, Minn.

Mortenson, P. C., Director of Research, The Massey-Harris Co., Tank Div., Racine, Wis.

Witting, Richard H., Packaging Technologist, Quartermaster Food and Container Inst., 1819 W. Pershing Rd., Chicago 9, Ill. For mail: 2957 N. Thirty-fifth St., Milwaukee 10, Wis.

CLEVELAND DISTRICT

Havens, Theodore A., Chief Engineer, Cleveland Tungsten, Inc., 10200 Meech Ave., Cleveland 5, Ohio.

DETROIT DISTRICT

Chieger, Dan, Assistant Director of Engineering, L. A. Young Spring and Wire Corp., 9200 Russell St., Detroit 11, Mich.

Hunter, Thomas A., Assistant Professor, Engineering Mechanics Dept., University of Michigan, Ann Arbor, Mich.

NEW ENGLAND DISTRICT

Abernathy, George C., Jr., Secretary-Treasurer, Boston Wool Trade Assn., 263 Summer St., Boston 10, Mass.

Burke, L. S., Cleverdon, Varney & Pike, 120 Tremont St., Boston 8, Mass.

Maxwell, Charles, Coats & Clark, Inc., Pine St., Pawtucket, R. I.

Milewski, L. A., Chief Engineer, Landers, Frary & Clark, New Britain, Conn.

Ramsay, Richard H., Manager, Bureau of Tests, Brown Co., Research and Development Dept., Berlin, N. H. For mail: 212 Park St., Berlin, N. H.

Ruley, Bryce, Chief Mathematician, New Departure Div., General Motors Corp., 269 N. Main St., Bristol, Conn. For mail: 60 High St., Bristol, Conn.

Schaffrath, P. W., Director of Research Dept., Oxford Paper Co., Rumford, Me.

Welch, Albert G., Research Associate Professor and Field Engineer, Engineering Experiment Station, University of New Hampshire, Durham, N. H. For mail: 7 Valentine Hill Rd., Durham, N. H.

NEW YORK DISTRICT

Rodvien, S., Manager, Mica Dept., The Otto Gerdau Co., 82 Wall St., New York 5, N. Y.

Stevens, Henry R., Engineering Consultant, Technical Associates, 71 Grove St., Paterson 3, N. J.

Wait, J. S., President, The Wait Associates, Inc., 51 E. Forty-second St., New York 17, N. Y.

Wechsler, Kenneth, Electrical Engineer, Mica Insulator Co., Box 1076, Schenectady 1, N. Y.

NORTHERN CALIFORNIA DISTRICT

Dunn, Alfred, Head, Materials Testing, Pioneer Rubber Mills, Box 791, Pittsburg, Calif.

Morin, Francis, President, Economy By-Products Co., Inc., 4200 Alameda Ave., Oakland 1, Calif.

Richards, Cedric, Assistant Professor, Department of Civil Engineering, Stanford University, Stanford, Calif.

Torburn, Donald Ivar, Chief Draftsman, Isoflex Corp., 947 Broadway Redwood City, Calif. For mail: 1506 Gover Lane, San Carlos, Calif. [J]*

OHIO VALLEY DISTRICT

National Board of Boiler and Pressure Vessel Inspectors, C. O. Myers, Secretary-Treasurer, 145 N. High St., Columbus 15, Ohio.

PHILADELPHIA DISTRICT

Manu-Mine Research and Development Co., Andrew Allan, Jr., Chief Mining Engineer, Box 167, Reading, Pa.

Dudley, George, Jr., Assistant Treasurer, The Narrow Fabric Co., Reading, Pa.

Fleck, J. Carl, Manager, Packaging Service Co., 135 Greenwood Ave., Wyncote, Pa.

Griffiths, Charles W., Director, Government and Industrial Research, R. M. Hollingshead Corp., Camden, N. J.

Smith, Tom S., Engineer of Tests, Central Cable Corp., 610 Washington Ave., Jersey Shore, Pa. For mail: R.D. 1, Jersey Shore, Pa.

Sudell, D. W., Superintendent, Cities Service Oil Co., Petty Island Plant, Box 927, Camden, N. J.

Webber, Thomas G., Chemist, E. I. du Pont de Nemours and Co., Inc., Wilmington 98, Del. For mail: 208 North Rd., Lindamere, Wilmington 3, Del.

PITTSBURGH DISTRICT

Brockway Clay Co., The, Edward L. Kilgus, President, Lock Box 1756, Brockway, Pa.

Bayles, Allison L., Partner, Bayles, Hollenbeck and Co., 522 Fifth Ave., New York 36, N. Y. For mail: 713 St. James St., Pittsburgh 32, Pa.

Feigenbaum, Simon, Chief Metallurgist, Pittsburgh Works, Jones & Laughlin Steel Corp., 2720 E. Carson St., Pittsburgh 3, Pa.

Oberlin, F. H., Chief Inspector, U. S. Steel Corp., Homestead Works, Munhall, Pa.

Shannon, Harry F., Research Associate, U. S. Steel Corp., Room 2414, 525 William Penn Place, Pittsburgh 19, Pa.

Williamson, Gilbert R., Field Engineer, Construction, 3131 West St., Rear, Weirton, W. Va.

ST. LOUIS DISTRICT

Hannan, Abdul, Civil Engineer, Kansas State Highway Commission, Topeka, Kans. For mail: 200 Jackson, Apt. 1, Topeka, Kans.

Lefton, Irvin M., Chief Chemist, Research Dept., Cook Chemical Co., 2500 Summit St., Kansas City, Mo.

Murakami, Hideo, Engineer, Chance Vought Aircraft, Inc., Dallas, Tex. For mail: 2709 Lincoln Way, Ames, Iowa. [J]

SOUTHERN CALIFORNIA DISTRICT

Janes, A. F., Owner, A. F. Janes Testing Laboratory, 220 E. Ortega St., Santa Barbara, Calif.

Schwartz, Harry E., Production Superintendent, H. Kramer and Co., 631 S. Aviation Blvd., El Segundo, Calif.

SOUTHWEST DISTRICT

Brigman, Ottis H., Purchasing Agent, Farnsworth & Chambers Co., Inc., Box 74, Houston, Tex. For mail: 3018 Broadmead Dr., Houston 25, Tex.

Frank, Harry M., President, The Atlas Building Products Co., Box 601, El Paso, Tex.

Hawes, T. P., Esso Laboratories, Esso Standard Oil Co., Box 551, Baton Rouge 1, La.

WASHINGTON (D. C.) DISTRICT

Poole, William D., Chief Metallurgist, Bethlehem Steel Co., Sparrows Point 19, Md.

WESTERN NEW YORK-ONTARIO DISTRICT

Wilson, James E., Chief Metallurgist, Brace Mueller Houtley, Inc., 1807 Elmwood Ave., Buffalo 7, N. Y.

UNITED STATES AND POSSESSIONS

Axelrod, Gerald J., AF 13400259, U. S. Department of the Air Force, 65 Fighter Inept. Sq., APO 942, c/o PM, Seattle, Wash. [J]*

Barrekette, E. S., Assistant Hydrographic Officer, U. S. Department of the Navy, U.S.S. *Maury* (AGS-16), c/o Fleet Post Office, New York, N. Y. [J]

Caulkins, Henry B., Jr., Assistant Plant Manager, Southern Chemical Cotton Co., Chattanooga 10, Tenn.

Claxton, A. W., Project Leader, Edgar Brothers Co., McIntyre, Ga.

Wheeler, Peyton, Research Dept., Edgar Brothers Co., McIntyre, Ga.

OTHER THAN U. S. POSSESSIONS

Cables, Conduits and Fittings, Ltd., W. K. Rybczynski, Approvals Supervisor, P. O. Drawer 70, St. Johns, P. Q., Canada.

Grant, Robert Donald, Materials Testing Engineer, Arabian American Oil Co., Dhahran, Saudi Arabia. [J]

Hadley, Walter C., Engineering Consultant, "Tralee," Paget, Bermuda.

Hamilton, David C., President, Hamilton Gear and Machine Co., Ltd., 950 Dupont St., Toronto 4, Ont., Canada.

Marquez, J. Miguel, Design Engineer, Shell Caribbean Petroleum Co., Avenida Vollmer, San Bernardino, Caracas, Venezuela. For mail: Edificio Concordia, Hoyo a Hospital, Caracas, Venezuela. [J]

National Technical University of Athens, Library, Twenty-eight October St., Athens, Greece.

Reece, James W., Technician, In Charge of Laboratory, Harry Bayley and Sons, Ltd., Hurdmans Rd., Ottawa, Ont., Canada For mail: Britannia Heights P.O., Ottawa, Ont., Canada.

Reed, Donald William, Chief Chemist, McColl-Frontenac Oil Co., Ltd., 51 Commissioners St., Toronto, Ont., Canada.

Tavera, M. G., Consultant Engineer, Nacional de Construcciones S. A., Carrera 7 No. 17-01 Oficina 517, Bogota, Colombia, S. A. For mail: Avenida Jimenez No. 8-27, Bogota, Colombia, S. A.

Thompson, A. D., Directing Engineer, Product and Research, Crane, Ltd., 1170 Beaver Hall Square, Montreal, P. Q., Canada.

* J denotes Junior members.

DEATHS...

John B. Brandeberry, Professor of Engineering Mechanics, and Acting Dean, College of Engineering, University of Toledo, Toledo, Ohio (September 23, 1953). Member of the Society since 1945. Member of the faculty of the University of Toledo since 1915.

Charles O. Burgess, Technical Director Gray Iron Founders' Society, Cleveland, Ohio (January 13, 1954). Personally affiliated with ASTM since 1949, but active previously for many years in technical work of the Society as representative of the Union Carbide and Carbon Research Laboratories, Mr. Burgess had made valued contributions to many phases of the Society's activities. He was especially active in Committees A-3 on

(*Continued on page 70*)

0.1% ACCURACY from 30 c to 100 kc

The Type 1610-A Capacitance Measuring Assembly

consists of five well-integrated G-R instruments for the accurate measurement of capacitance and dissipation factor. *Two or three-terminal measurements are possible.*

In addition to its usefulness in electrical development and testing, the Capacitance Measuring Assembly finds wide application in the dielectrics laboratory and chemical research organization. The close relationship between capacitance and dissipation factor and the physical and chemical composition of a substance make this precision apparatus very useful for investigations in countless basic research problems.

★ *This assembly is widely used in conjunction with the G-R Sample Holder to study dielectric properties of plastics and other insulating materials such as steatite, teflon, polystyrene, mica and others.*

★ *Effects of interfacial polarization at low audio frequencies and dipole polarization in polymers may be investigated.*

★ *Characteristics and effects of surface water films may also be studied.*

★ *The Capacitance Measuring Assembly offers one of the best methods for measuring the Boella effect in high-valued resistors.*

★ *Characteristics of large inductors as well as resistors may be determined by substitution measurements.*

The five G-R instruments included in the Capacitance Measuring Assembly are assembled in a compact cabinet-rack complete with all interconnection provisions.

Type 1302-A Oscillator . . . supplies up to 80-milliwatts from 10 c to 100 kc.

Type 1231-BRA Amplifier and Null Detector . . . 100 μv input gives 10% meter deflection at mid-frequency range.

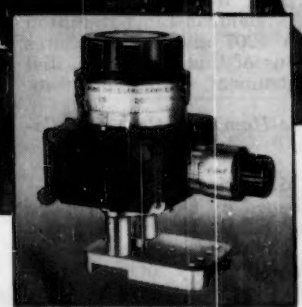
Type 1231-P5 Adjustable Filter . . . has eleven fixed frequencies . . . with external capacitors, any resonant frequency from 20 c to 100 kc can be obtained.

Type 716-P4R Guard Circuit . . . makes possible accurate impedance determinations between two points of a three-terminal network.

Type 716-C Capacitance Bridge . . . measures 0.1 $\mu\mu$f to 1150 $\mu\mu$f from 30 c to 300 kc and to 1 μf at 1 kc . . . direct reading in dissipation factor from 0.00002 to 0.56 . . . basic direct reading accuracy is ±0.2% for capacitance and ±0.0005 for dissipation factor; in substitution measurements, ±0.1% capacitance accuracy with correction chart supplied, and ±0.00005 for dissipation factor.

Type 1610-A Capacitance Measuring Assembly . . Complete and ready for two or three-terminal measurements **$1930.00**

Type 1610-A2 Capacitance Measuring Assembly . . . Without Guard Circuit, for two terminal measurements only . . . **$1635.00**



The unique Type 1690-A Dielectric Sample Holder is an accessory unit readily attached to the bridge unknown terminals. It permits precise determinations of dielectric constant and dissipation factor of practically any solid dielectric-material.

The sample holder's 2-inch diameter electrodes are ground to optical flatness and are micrometer driven for highest accuracy. The instrument is rugged, completely shielded and useful to 100 Mc and higher.
Additional Price $435.00

Since 1915
Manufacturers of Electronic Apparatus for Science and Industry

General Radio Company

275 Massachusetts Ave., Cambridge 39, Massachusetts

West Street 920 South Michigan Avenue 1000 North Seward Street
NEW YORK 6 CHICAGO 5 LOS ANGELES 38

Admittance Meters ☆ Amplifiers ☆ Coaxial Elements ☆ Distortion Meters ☆ Frequency Measuring Apparatus ☆ Frequency Standards ☆ Impedance Bridges ☆ Light Meters Megohmmeters ☆ Modulation Meters ☆ Polariscopes Precision Capacitors ☆ Oscillators ☆ U-H-F Measuring Equipment ☆ Parts & Accessories ☆ Signal Generators Wave Analyzers ☆ Variacs ☆ TV & Broadcast Monitors Pulse Generators ☆ R-L-C Decades ☆ R-L-C Standards ☆ Unit Instruments ☆ Sound & Vibration Meters ☆ Stroboscopes ☆ Null Detectors ☆ Motor Controls ☆ Wave Filters ☆ V-T Voltmeters

(*Continued from page 68*)

Cast Iron, and A-7 on Malleable-Iron Castings, heading many subgroups, and serving as Secretary of A-3 from 1944 to 1949, and Chairman of A-7 from 1944 to 1946. He had been a member of Committee E-5 on Fire Tests of Materials and Construction in earlier years, and had served on Committee E-7 on Non-Destructive Testing since its organization in 1938. An internationally known metallurgist and author of technical articles on iron and steel, he had given unstintingly of his knowledge and time in the deliberations of those groups with which he was associated. In 1952 he was elected to the ASTM Cleveland District Council, and in 1953 was chosen as its Vice-Chairman.

Other organizations with which he was actively affiliated include the American Foundrymen's Society, American Society of Mechanical Engineers, American Society of Metals, American Institute of Mining and Metallurgical Engineers, National Academy of Science, American Ordnance Association, and American Society for Quality Control. He held more than a dozen patents in the steel and gray iron fields, and at the time of his death was nearing completion of a gray iron handbook for users of castings.

George B. Hogaboom, first President, Founder and Honorary Member of the American Electroplaters' Society, died at the age of 79 on the last day of 1953. (Residence, New Britain, Conn.) A member of ASTM from 1927 to 1946, Mr. Hogaboom had served on a number of the technical committees: A-5 on Corrosion of Iron and Steel, B-3 on Corrosion of Non-Ferrous Metals and Alloys, B-8 on Electrodeposited Metallic Coatings, and D-12 on Soaps and Other Detergents. A pioneer researcher and leader in the electroplating field, he had worked through the years in various supervisory capacities in the plating departments of the International Silver Co., P & F Corbin Division of the American Hardware Corp., Hanson-Van Winkle-Munning Co., and also acted as a consultant. He served the Government as a technical adviser during both World Wars.

Charles J. Huber, Consulting Engineer, Sanderson & Porter, New York City (December 22, 1953). Member since 1942, and previously representative of the U. S. Testing Co., Inc., Hoboken, N. J., in technical committee work of the Society. He served in earlier years on Committee B-7 on Light Metals and Alloys, also was representative of ASTM on the Inter-Society Color Council from 1940 to 1943. He had been a member of Committee D-13 on Textile Materials continuously since 1935, serving on many subgroups.

Dwight Rist Judson, President and Treasurer, The Dwight R. Judson Co., Hartford, Conn. Member since 1919.

Victor M. Mantz, Director of Government and Industrial Research, R. M. Hollingshead Corp., Camden, N. J. (October 17, 1953). Member since 1941, and active in the work of Committees A-5 on Corrosion of Iron and Steel; D-1 on Paint, Varnish, Lacquer, and Related Products; D-12 on Soaps and Other Detergents; and D-21 on Wax Polishes and Related Materials.

Lewis W. Mesta, Executive Vice-President and Director, Mesta Machine Co., Pittsburgh, Pa. (December 30, 1953). Representative of company membership since 1931.

George W. Miller, Chief Chemist, W. J. Voit Rubber Corp., Los Angeles, Calif. (September 29, 1953). Member since 1951.

Richard W. Parsons, Technical Director, The Ohio Brass Co., Mansfield, Ohio (October 10, 1953). Representative of company membership since 1946; also representative of his company on the following committees: A-5 on Corrosion of Iron and Steel; A-7 on Malleable-Iron Castings; B-2 on Non-Ferrous Metals and Alloys; and B-5 on Copper and Copper Alloys.

Nelson M. Powell, Vice-President, Dyer-Clark Co., Lawrence, Mass. (February 21, 1953). Member since 1924.

Thomas D. Sedwick, Retired Engineer of Tests, Chicago, Rock Island & Pacific Railway Co., died in Florida, December 3, 1953 (Interment in Fayette, Ark.). Member since 1916, and for many years an active participant in the deliberations of Committees A-1 on Steel, A-2 on Wrought Iron, and D-1 on Paint, Varnish, Lacquer, and Related Products.

John P. Sheehan, Partner, The Atlas Building Products Co., El Paso, Tex. Member since 1949.

Bertrand H. Wait, President, The Wait Associates, Inc., New York City (July 20, 1951). Member since 1931.

John E. Whelan, Laboratory Supervisor, City of Boston, South Boston, Mass. (October 19, 1953). Member since 1947.

Lazarus White, President, Spencer, White & Prentis, Inc. (July, 1953). Member since 1937. Active for many years in Committee D-18 on Soils for Engineering Purposes, and several of its subgroups.

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Please mention ASTM BULLETIN when writing to suppliers

CATALOGS AND LITERATURE

New Electric Heat Source—A new electric heat source, announced by American Instrument Co., provides controlled heat input for softening-point tests of bituminous materials and makes control of temperature-rise rate easy and certain. It is suited for use in making softening-point tests in accordance with ASTM Designations D 36, D 61, E 28. Details are given in Bulletin 2246.

American Instrument Co., Inc., Silver Spring, Md.

Vacuum Ultraviolet Monochromator—A four-page bulletin, now available from Baird Associates, Inc., illustrates and describes the Ultraviolet Monochromator. Bulletin XL covers following sections: grating and grating drive, light baffles, slits, camera, ultraviolet detector, and vacuum system.

Baird Associates, Inc., 33 University Rd., Cambridge, Mass.

Whittemore Strain Gage—The improved Whittemore strain gage is described in a new illustrated two-page bulletin by Baldwin-Lima-Hamilton Corp. Bulletin 1207 gives the features and specifications of this hand type, dial micrometer instrument for 2 and 10-in. gage lengths.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Electrical Measuring Instruments—Bulletin 108, issued by Central Scientific Co., describes and illustrates electronic and electrical measuring instruments and accessories for laboratory or industrial requirements. Some of the equipment described in this twelve-page bulletin includes: electronic electrometers, electronic relays, audio frequency oscillators, Wheatstone bridges, potentiometers, resistance standards, and oscilloscopes. Copy free on request by writing Dept. Adv. 108.

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Isotemp Ovens—An illustrated eight-page bulletin available from the Fisher Scientific Co. features isotemp ovens. Advantages listed for these ovens include: uniform temperature throughout, constant temperature, high efficiency, economy, attractive construction, safety precautions, and simple controls. Three models are described in Bulletin FS-230: isotemp oven, senior isotemp oven, and forced draft isotemp oven.

Fisher Scientific Co., 1717 Forbes St., Pittsburgh 19, Pa.

Coordinate Cathetometer—A new bulletin describing the M1236 coordinate cathetometer for making coordinate measurements in a vertical plane has been announced by the Gaertner Scientific Corp., Bulletin No. 188-53. General information lists apparatus, readings, mounting, and dimensions. Additional information from the company.

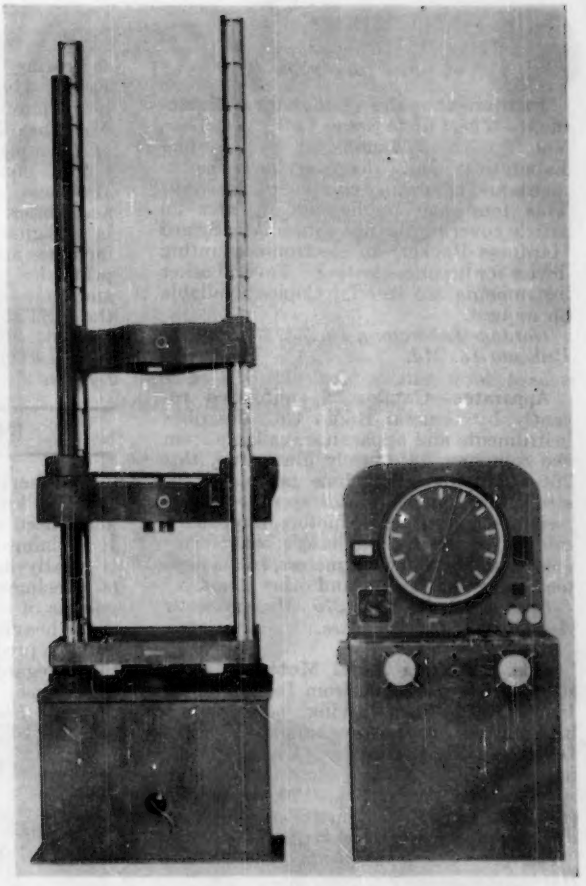
Gaertner Scientific Corp., 1201 Wrightswood Ave., Chicago 14, Ill.

(*Continued on page 72*)

TESTING UNLIMITED

at costs you can afford!

Which of these quantities should you measure to do a better job of quality control?



Tension, Compression, Traverse, Fatigue—	Young Universal Testing Machines cover a range of 1,000 lbs to 5,000,000 mechanically or hydraulically driven complete with all accessories.
Thrust Load—	Young Thrust-Load Weighing Systems are available in pneumatic, hydraulic, or electrical models.
Strain—	Young Type A Strain Indicators include many unique design features. Also available are static and hi-speed switching units for up to 200 gages per sec. Young Bond Checkers check your strain gage application in 10 seconds.
Oscillographic—	Young Oscillographs cover from 6 to 60 channels; Amplifiers from 4 to 8 channels. Hi-speed cathode ray recorders, up to 8 traces, have paper speeds up to 150″ per sec. on 6″ wide paper. Developing and drying equipment for paper and film up to 18″ wide is available in combination and automatic units.
Special Measuring Instruments—	Others in the Young line include Huggenberger instruments; XY recorders up to 48 channels; hi-speed motion picture cameras. Special testing machines for cable, torsion, etc., manufactured to your specifications.

Here is the finest in testing priced to meet your budget. Based on years of specialized design and production of test equipment, Young offers you a versatility and knowledge that can solve your testing problems at minimum cost. If a standard machine is not the most economical answer, you'll find our engineers glad to design a machine that is. A letterhead request brings details. . . . write today.

Young Testing Machine Co.

750 Lancaster Ave. • P.O. Box 233-A
Bridgeport, Penna.

(*Continued from page 70*)

Instruments and Laboratory Equipment—The first issue of *Newsletter*, Vol. 1, No. 1, published by Gardner Laboratory, Inc., describes new instruments and laboratory equipment available. This four-page publication features an article covering the new Automatic Sward Hardness Rocker, an electronic counting device for hardness testing. Several other instruments are listed. Copies available on request.

Gardner Laboratory, Inc., 4723 Elm St., Bethesda 14, Md.

Apparatus—Catalog N, published recently by General Radio Co., describes instruments and apparatus available from the company. Profusely illustrated, this 264-page publication lists industrial instruments, variacs, motor speed controls, resistors, capacitors, inductors, impedance bridges, amplifiers, oscillators, waveform-measuring instruments, meters, frequency-measuring equipment, and other items.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Side Indicating Panel Meter—A data sheet is now available from International Instruments, Inc., giving performance information on the new miniature Side Indicating Panel Meters. The engineering data sheet gives description and specifications of Model 1120, including standard ranges and meter and flange drawings. Copy free on request.

International Instruments, Inc., New Haven 15, Conn.

General Laboratory Apparatus—A recent issue of the *Machlett Announcer* contains several articles dealing with scientific equipment. An article entitled "Glass for Science from Corning Research" features this issue. Some of the items listed in this magazine: ultra-speed electro-analyzer, international centrifuges, operation time recorder, micropipet, carbon combustion trains, and viscosimeters.

E. Machlett & Son, 220 E. 23rd St., New York 10, N. Y.

Explosion-Proof Switches—Data Sheet 84 recently published by Minneapolis-Honeywell Regulator Co., lists characteristics, mounting variations, and electrical rating of EX-AR and EX-Q type explosion-proof switches.

Minneapolis-Honeywell Regulator Co., Micro Div., Freeport, Ill.

New Automatic Scaler—A specification sheet published by the Nuclear Instrument and Chemical Corp. describes the Model 183 scaler which may be used with Geiger or scintillation counters for precise automatic measurements of radioactivity.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

Proof-Tests Cable and Wire—A new tester for prestretching and proof-testing aircraft cable and other wire assemblies is announced by Riehle Testing Machines Div. The new 6500-lb capacity Multiple Cable and Wire Tester tests five different sizes of cable simultaneously, it is claimed. Built with five separate tensioning units, all with different ranges, each unit can be preset to exert any load within its range, for any period from three seconds to twenty minutes.

Riehle Testing Machines Div., American Machine and Metals, Inc., East Moline, Ill.

Testing Machines—A new catalog of Brinell Hardness Testing Machines has been published by Steel City Testing Machines, Inc. Included are illustrations and complete specifications on more than half a dozen different types of Brinell Hardness Testers, plus miscellaneous accessories. This eight-page publication is designated as Bulletin B 953. It includes an explanation of some of the principles of Brinell Hardness Testing and some of the standards set forth by the ASTM on this subject. Copies on request.

Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit 28, Mich.

INSTRUMENT NOTES

Weather-Ometer—A new Weather-Ometer, known as the Model DMC, is announced by Atlas Electric Devices Co. It is claimed that accuracy in test results is greatly increased by a positive control of specimen temperatures. A constant volume of air at a controlled temperature in the heavily insulated cabinet, maintains uniform predetermined specimen temperatures regardless of variations in room conditions.

Atlas Electric Devices Co., 361 W. Superior St., Chicago, Ill.

Pressure Pickup—Where pressure transients occur too rapidly for observation with conventional indicating devices, the new electrical resistance unit Type 4-312 Pressure Pickup provides immediate response to pressure changes. This miniature pickup announced by Consolidated Engineering Corp., is available in gage, absolute, and differential models which feature high corrosion resistance and a flush-type diaphragm. It may be used for either liquid or gaseous measurements. For further details request Bulletin CEC-1540 from Company.

Consolidated Engineering Corp., Pasadena 15, Calif.

New Instrument Unscrambles Meta Mix-ups—Announcement has been made by the J. W. Dice Co. of the new Model C-1 Cyclograph for rapid nondestructive testing and sorting of accidentally mixed or incorrectly processed metal parts. The instrument can be used on either ferrous or non-ferrous metals and will sort raw stock, semifinished, or finished parts by their metallurgical characteristics such as analysis, hardness, structure, case depth, etc.

J. W. Dice Co., Englewood, N. J.

New Tank Thermometer—Development of the "Scoop-Master" has been announced simultaneously by the Ever Ready Thermometer Co., and the Weksler Thermometer Corp. The "Scoop-Master" is constructed of plastic. Cup capacity of 120-ml meets with API and ASTM requirements. Further information from either of the developing sources.

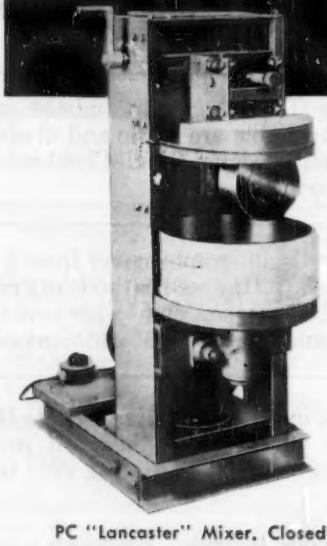
Ever Ready Thermometer Co., 88 Park

(*Continued on page 74*)

SAVE MONEY

by the "test" batch!

Lancaster® Mixers



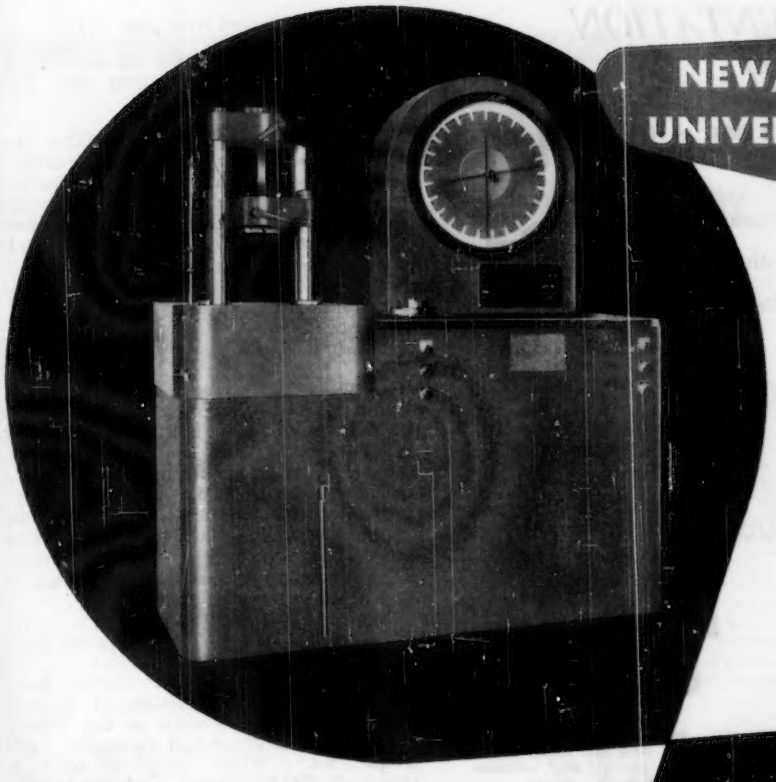
PC "Lancaster" Mixer. Closed pan type with muller showing mixing tools in raised position. Specially designed for laboratory work.

The accuracy of test batch mixing greatly influences production costs. The precision of "Lancaster" Mixing is the same in small laboratory machines and in large production sizes. "Lancaster" Mixers save hours and valuable materials both in the laboratory and in production through balanced mixing - mulling action. Available in 7 unit sizes and 26 models. Write today.

POSEY IRON WORKS, Inc.

Brick Machinery Division

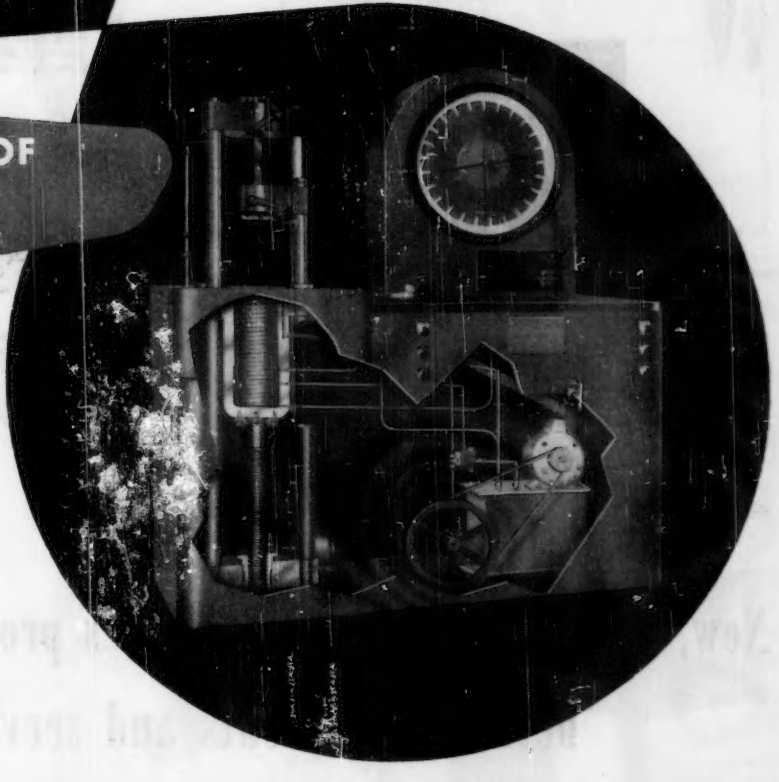
LANCASTER, PENNSYLVANIA



NEW, COMPACT SINGLE UNIT UNIVERSAL TESTING MACHINE

- Built as a single unit so that floor load is distributed over large area.
- Overall dimensions less than two unit machine (only 67½" wide by 27" deep).
- More compact machine (indicator only 77½" high and loading cage 73¼" high).

WITH ADVANTAGES OF TWO-UNIT DESIGN



- Gage panel is supported separately by a framework which extends to the floor, preventing the shock of breaking specimens from being transmitted to the load indicator.
- Therefore, recoil is not transmitted to the indicator and cannot jar the maximum hands out of position.
- Friction of the maximum hands can be adjusted to the maximum necessary for accurate indication.

This low-cost Baldwin 60-H universal testing machine of 60,000 lb. capacity has many other advantageous features. For complete technical information please write for Bulletin 4204 to Dept. 2103, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

TESTING HEADQUARTERS

BALDWIN-LIMA-HAMILTON

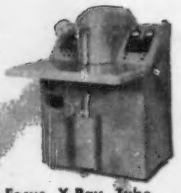
General Offices: Philadelphia 42, Pa. • Offices in Principal Cities

In Canada: Peacock Bros., Ltd., Montreal, Quebec

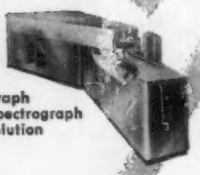
IT TAKES TOP INSTRUMENTATION TO DO TOP RESEARCH

JAco INSTRUMENTS GIVE YOU THE SPEED AND PRECISION YOUR WORK DEMANDS

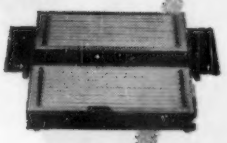
Whatever your research job, JAco makes instruments that will help you do it faster, more easily and with greater precision. So why handicap your research results with make-do or unreliable equipment — get the JAco Instruments right for your job and see how often difficult jobs become routine.



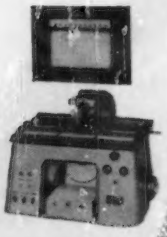
Micro-Focus X-Ray Tube
Widely adaptable research tool with ultra-precise features



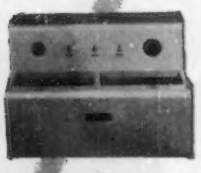
3.4 Meter Spectrograph
A completely automatic spectrograph with outstanding resolution and dispersion



Gamma Correcting Fan-Scale Calculator
Saves time and effort in computing gammas and emulsion characteristic curves

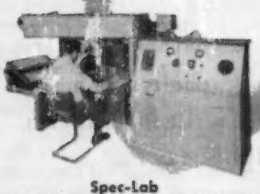


Recording Comparator Microphotometer
Combines high sensitivity and high linearity with ease of use



Photographic Processing Unit
Self-contained unit for rapid and precise development of film or plates

New, expanded JAco facilities provide better instruments and service than ever before...



Spec-Lab
Spectrograph, source, microphotometer and accessory equipment in one low-cost package

Write for catalogs on these JAco Instruments today

JAco **JARRELL-ASH COMPANY**
26 FARWELL STREET, NEWTONVILLE, MASS.

Spectrographs—Source Units—Microphotometers—Spectrographic Laboratory Accessories—X-Ray Equipment—Geophysical Instruments—Refractometers—Polarimeters—Microscopes

SALES OFFICES

DETROIT	EL CERRITO, CAL.	CHATTANOOGA	QUEENS VILL., N. Y.
13680 Capitol Ave.	1344 Devonshire Drive	1431 Broad Street	80-56 230th Street

(*Continued from page 72*)

Place, New York, N. Y.; Weksler Thermometer Corp., 49 W. 32nd St., New York 1, N. Y.

The Vibro-Mixer—An apparatus designed to add more power and versatility to closed-system mixing in the laboratory has been developed by Fisher Scientific Co. The Vibro-Mixer has an enclosed motor vibrating a shaft 120 times a second; a control regulating the unit over a range that encompasses strokes 0.2 mm to strokes 2 mm in thrust.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

New Pouring Spout—A new pouring spout announced for small containers provides safety, avoids fumes, odors, and prevents waste and spilling of liquids. Type SO, available from General Scientific Equipment Co., is designed to prevent accidents and to save materials, caused by spilling and splashing when pouring liquids into smaller containers. This unit is made of acid-resistant rubber and plastic tubing to give long life.

General Scientific Equipment Co., 2700 W. Huntingdon St., Philadelphia 32, Pa.

Interpolator—Gertsch Products, Inc., announces the manufacture of a new VHF Interpolator known as the Model AM-1 for generating and measuring high frequencies. When supplied with a standard 100-kc signal, and used with auxiliary measuring equipment in the range of 1 to 2 mc, it provides a system of measurement or generation of frequency in the range of 20 to 1000 mc, with an accuracy of better than 1 part in 10^7 depending upon the accuracy of the 100-kc crystal source.

Gertsch Products, Inc., 11846–48 Mississippi Ave., Los Angeles 25, Calif.

Analytical Balance—E. Machlett & Son has announced a new, single-pan analytical balance. Named the Emson Model S-M Balance, this new instrument was created and produced by Wilhelm Spoerhase Co. of Western Germany. According to the company, the chief advantage of the Model S-M Balance is that it minimizes operator fatigue and still gives the greatest speed, simplicity, reproducibility, and dependability. It is stated that extensive tests with the apparatus have shown actual weighing times to average less than 18 sec.

E. Machlett & Son, 220 E. 23rd St., New York 10, N. Y.

Laboratory Dry Ice Pulverizer—A new laboratory dry ice pulverizer has been announced by Franklin P. Miller & Son, Inc. Trade named "Supreme," the new machine makes 100 per cent powdered solid carbon dioxide from chunks. It crushes the solid carbon dioxide at the rate of 8 lb per min to minimize the condensation of moisture into the pulverized material.

Franklin P. Miller & Son, Inc., 36 Meadow St., East Orange, N. J.

Pyrometer Controllers—The range of applications for millivolt-type pyrometer control instruments made by the Minneapolis-Honeywell Regulator Co. has been broadened by the addition of millivolt actuation, the company recently announced. The measuring circuits of the instruments, known as Pyr-O-Vane and Protect-O-Vane controllers, have been modified to permit calibration of the instrument for a number of functions

(*Continued on page 76*)

WHATMAN

Filter Papers for Gravimetric Analyses

For all determinations where the filter papers must be ashed and the precipitate weighed WHATMAN Filter Papers washed in HCl and HF are specified by experienced analysts.

No. 40 is the general purpose grade, Nos. 41 and 41-H for large particle or gelatinous precipitates, No. 42 for fine precipitates, while No. 44 is used where minimum absorbency is essential. No. 43 is the fat free quality used mostly in biological chemistry.

Why not send for samples of these fine papers today?

H. REEVE ANGEL & CO. INC.

52 Duane St. New York 7, N. Y.

Remember that for chromatography and electrophoresis WHATMAN Filter Papers and Cellulose Powders are World Renowned.

WHATMAN High Grade FILTER PAPERS

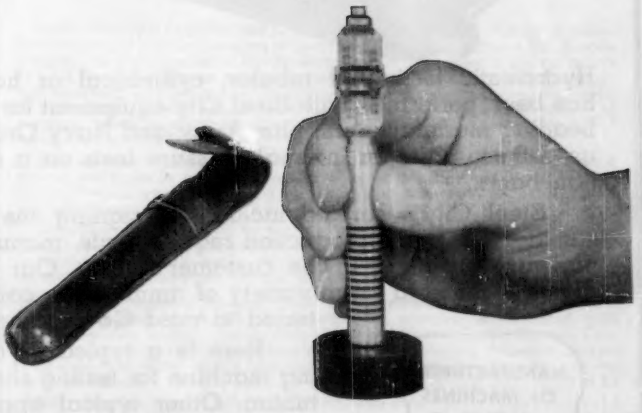
your copy of this 36 page catalog is ready!

Write now for your FREE copy of the Emil Greiner Catalog of Hydrometers and Thermometers. The most complete of its kind ever published. Features nearly 1000 models made in accordance with requirements of the National Bureau of Standards, ASTM, API and other official sources of standard specifications.

The EMIL GREINER Co.
20-26 N. Moore St., N. Y. 13, N. Y.

The Emil Greiner Co., Dept. D
20-26 N. Moore St., New York 13, N. Y.
Please send me Hydrometer and Thermometer Catalog.
Name .....
Company .....
Address .....
City ..... Zone ..... State .....

REX RUBBER HARDNESS GAUGE
LIFETIME ACCURACY



A PRECISION VEST POCKET INSTRUMENT indicates hardness as specified by ASTM ● Direct Acting ● Holds Readings ● Rugged ● Reliable ● Weighs 1½ ounces ● No gears, cams or levers ● No recalibrations ● No adjustments

GUARANTEED FOR LIFE

Write for free Descriptive Literature

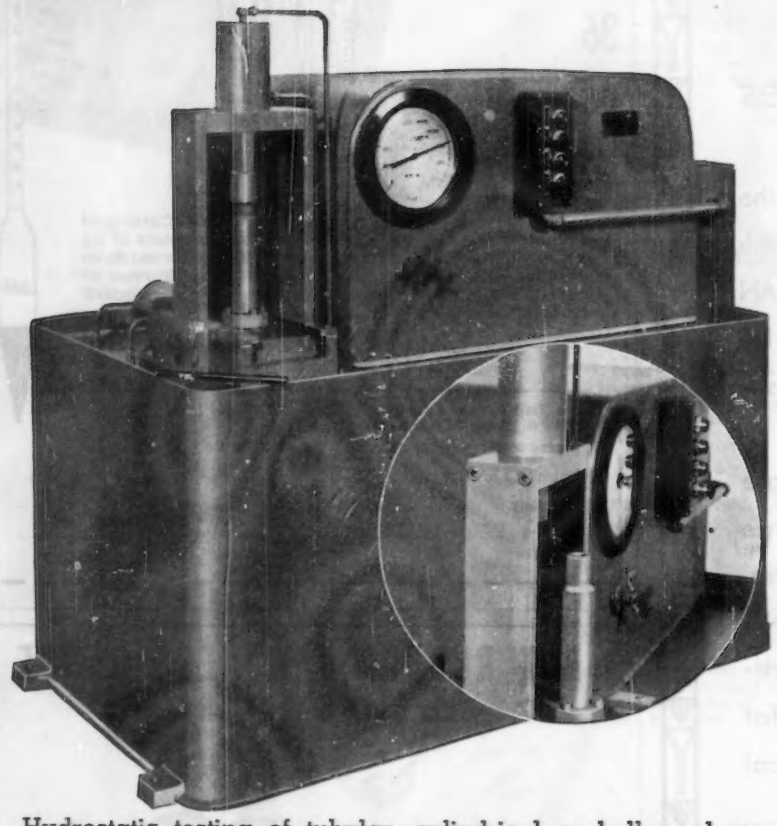
W. F. ORTH
800 S. ADA ST., CHICAGO 7, ILL.

EXPORT OFFICE: 306 W. WASHINGTON ST., CHICAGO 6, ILL.

HYDROSTATIC TESTING MACHINES

DESIGNED BUILT INSTALLED

the **COMPLETE JOB** *to meet your demands!*



Hydrostatic testing of tubular, cylindrical or hollow shapes has been performed with Steel City equipment for many years. Leading manufacturers, plus Army and Navy Ordnance, have used these units for internal pressure tests on a mass production basis.

Steel City's service includes designing the machine to satisfy testing and production requirements, manufacturing the unit and installing in the customer's plant. Our varied experience includes a large variety of ammunition components, all tested to rigid Government standards.

Here is a typical hydrostatic testing machine for testing short lengths of tubing. Other typical applications are described and illustrated in a descriptive bulletin. If you have a hydrostatic testing problem, write for your copy or the name of our nearest Sales Representative.

MANUFACTURERS OF MACHINES FOR TESTING PHYSICAL PROPERTIES OF METALS

Brinell, Ductility, Universal, Tensile, Compression, Transverse, Hydrostatic, Special Testing Machines, Flex-Tester and Proving Instruments

Steel City Testing Machines Inc.

8813 LYNDON AVE. • DETROIT 21, MICH.

(*Continued from page 74*)

including measuring and controlling speed of rotation, power consumption, pressure, or relative acidity or alkalinity. The instrument is expected to be particularly suited for various uses in research or development activities where the extreme sensitivity and versatility of potentiometer type instruments is not required.

Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia, Pa.

Program Controllers—Development of automatic testing Program Controllers has been announced by the Tinius Olsen Testing Machine Co. for automatic production and quality control testing as well as research programs. Controllers are designed for production testing, proof testing, yield strength by the extension under load method, stress cycling (load), strain (unit deformation) cycling and crosshead cycling. Detailed information available from company.

Tinius Olsen Testing Machine Co., 1120 Easton Rd., Willow Grove, Pa.

Thin Wall Jacketed Counter—Radiation Counter Laboratories, Inc., has announced the development and availability of a new Thin Glass Wall Jacketed Geiger Counter, RCL Mark 1 Model 71. This counter is used for monitoring radioactivity where processes involving continuous flow are involved—for example, engine wear studies. For further information, write Dept. PF-12.

Radiation Counter Laboratories, Inc., 5122 W. Grove St., Skokie, Ill.

Hot Plate—Recently announced by Thermo Electric Manufacturing Co., the new 2600 Series hot plate is designed for lasting service under especially hard use in both plants and laboratories. On the production line it serves for melting pitch, resins, waxes, sealing of plastic wrappings, etc. In the laboratory it is used for boiling, extractions, and routine heating.

Thermo Electric Mfg. Co., P. O. Box 697, Dubuque, Iowa.

Test Chamber Model—Announcement has been made by Webber Manufacturing Co. of Test Chamber Model A-30-40FH, designed for large capacity testing at high and low temperatures. Features include visible type controller, patented heat exchangers and multi-paned visual port and apertures for connections to inner chamber. Temperature range is to −40 F on refrigeration cycle and to +200 F on heat cycle.

Webber Manufacturing Co., Inc., Dept. 366, 2740 Madison Ave., Indianapolis 3, Ind.

INSTRUMENT COMPANY NEWS

Baird Associates, Inc., Cambridge, Mass.—As a result of the annual meeting of directors and stockholders of Baird Associates, Inc., Dr. Walter S. Baird, president of the company, announced the election of William H. Congleton as a director of the company. Mr. Congleton is the technical director of American Research & Development Corp. Dr. Baird also announced the election of Dr. Bruce H. Billings as vice-president for research and development. Dr. Billings, research director of Baird Associates since 1947, is in charge of the company's program of research and development in the field of electronics and electromagnetic radiation.

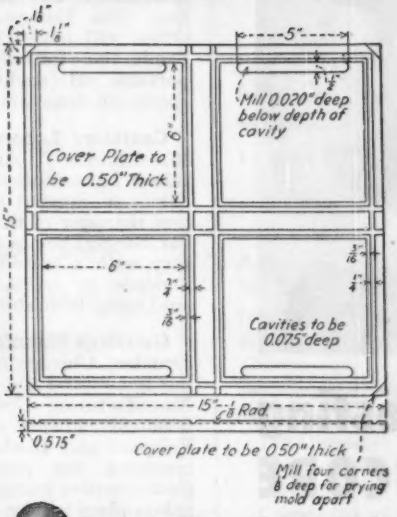
(*Continued on page 78*)

MOLDS AND DIES

HOGGSON BRAND *Since 1849*

FOR RUBBER TESTING

Single and multi-cavity molds made to order for making samples for testing adhesion, abrasion, flexing, compression, rebound. Years of experience in rubber. Prompt service.



BENCH MARKER

1" and 2" Centers

Standard ASTM and Federal dies for cutting test tensile and tear strength samples and dies for Slab curing carried in stock. Write for catalog.

HOGGSON & PETTIS MANUFACTURING CO.
133 Brewery St.
NEW HAVEN 7, CONN.
Pac. Coast: H.M. Royal, Inc., Los Angeles

KLETT MADE

Colorimeters

Visual

Photo-Electric

Special Types For Testing

Colors Petroleum Products

Glass Color Standards

Glass Cells

Fluorimeter

Nephelometer

Complete Electrophoresis Equipment

KLETT MANUFACTURING COMPANY
Manufacturers of Scientific Instruments
179 East 87th Street New York 28, N. Y.

A.H.T. CO. SPECIFICATION

KARL FISCHER TITRATION OUTFIT

FOR DETERMINATION OF WATER CONTENT

4935-P.

KARL FISCHER ELECTROMETRIC TITRATION OUTFIT. For the quantitative determination of small amounts of water by titration with iodine-sulfur dioxide reagent. Particularly suitable for the determination of moisture in a great variety of solid, liquid and gaseous samples because it is more rapid, dependable, specific and universally applicable than the common methods of oven drying, distillation or absorption. Further adaptation of the method permits analytical control of reactions which quantitatively absorb or liberate water. Adopted by ASTM for standard method D 890-51.

Tests are made in inexpensive commercial jars with G.C.M.I. No. 63 standard thread, which can be used interchangeably in the threaded cap of the Titration Cell. Samples can be prepared in advance as the jars with caps prevent moisture change.

Detection of the endpoint by means of platinum electrodes and electron ray "magic eye" tube offers dependable and uniform results, and is particularly useful in analyses producing highly obscured endpoints. Magnetic stirring affords advantages of simplicity and external application of power.

4935-P. Electrometric Titration Outfit for Determination of Water Content, Karl Fischer Method, A.H.T. Co. Specification, complete as illustrated, with paired reservoir burettes, titration cells 140 ml and 250 ml, Serfass Titration Control Unit, electron ray tube, in separate cylindrical housing, Magnetic Stirring Apparatus with three stirring bars, support, clamps, and directions for use, but without reagents. For 115 volts, 50 or 60 cycles, a.c. 274.82

6276. Titration Vessel (Jelly Jar), 140 ml, with metal cap ..... .14

4935-S. Ditto, 250 ml, with plastic cap ..... .28

NOTE—Beckman Model H-2 pH Meter with polarizing adapter (price $2.35) is an excellent substitute for Serfass Control Unit in above outfit. Price of Outfit without Serfass Control Unit 174.92

Price of Outfit complete with Model H-2 pH Meter and polarizing adapter in place of Serfass Control Unit 402.27

ARTHUR H. THOMAS CO.
Laboratory Apparatus and Reagents
WEST WASHINGTON SQUARE
PHILADELPHIA 5, PA.
Teletype Services: Western Union WUX and Bell System PH-72

$1,000,000 SAVED

with the Sperry ultrasonic testing REFLECTOSCOPE

YOU TOO CAN CUT PRODUCTION AND MAINTENANCE COSTS — *whatever the size of your plant* — with this latest development in portable, nondestructive testing instruments.

THE ULTRASONIC REFLECTOSCOPE enables you to "see" inside a variety of metals and other materials. By means of a distinct pattern on a cathode ray tube, it enables you to locate and evaluate — *quickly, economically* — both surface and internal defects.

APPLICATIONS are unlimited. You can cut wasted machine- and man-hours through *fast, accurate quality-control* of raw materials and machined parts. You can eliminate serious production delays through discovering fatigue cracks in your heavy equipment *before they lead to breakdown.*

OPERATION is simple — all electronic circuits are practically automatic. Penetration is deep — 30 feet, for example, in solid steel.

THIS UNIQUE INSTRUMENT is now available to you through: (1) direct purchase, (2) lease for any period from two months up, or (3) "commercial testing" (we'll send a Sperry Inspection Engineer with Reflectoscope right to your plant, or test in our own laboratories materials you ship us).

OUR NEW BULLETIN 50-105 tells the whole story . . . just *how, where* and *why* the Ultrasonic Testing Reflectoscope can cut your costs from raw materials to finished product. To get your copy immediately, fill out and mail the attached coupon today.

* "We have had over two years experience in nondestructive testing with the Sperry Ultrasonic Reflectoscope. It has been used for the regular inspection of all our extrusion presses. Some 19 press columns have been removed before failure on data provided by the Reflectoscopes. The resultant savings in press damage and down time are estimated to exceed well over $1,000,000."
— Aluminum Company of America

TYPICAL TEST PATTERNS on Reflectoscope screen. At left, material O.K. At right, center "reflection" indicates and locates defect.

SPERRY PRODUCTS, INC.
Leader Since 1928
in Nondestructive Testing

Sperry Products, Inc.
1700 Shelter Rock Road
Danbury, Connecticut

☐ Please send me a copy of your new Bulletin 50-105.

☐ Have your representative call.

Material to be tested.....
Name.....
Title.....
Company.....
Address.....
City..... Zone..... State.....

(*Continued from page 86*)

Beckman Instruments, Inc., South Pasadena, Calif.—Opening of a branch assembly plant and European Sales headquarters in Munich, Germany, has been announced by Beckman Instruments, Inc. The European Sales and Service Office will cover 18 countries overseas. Production initially will be limited to portable pH (acidity) meters and quartz spectrophotometers.

Container Laboratories, Inc., Chicago, Ill.—Charles J. Zusi, president of Container Laboratories, has announced that James A. Sargent has been appointed as new manager of the Chicago Laboratory. Mr. Sargent comes to the Chicago Laboratory with a considerable amount of experience in military packaging and in packaging laboratory work.

Gundlach Manufacturing Corp.—Albert Drucker, Chicago engineer and inventor, has announced the purchase of Gundlach Manufacturing Corp., producer of professional cameras and custom lenses, in Fairport and Rochester, N. Y. In announcing the purchase, Drucker said that extensive reorganization and modernization plans will be placed in effect during 1954. Present staff and plant facilities will be maintained. Four separate operating divisions will be established.

Leeds & Northrup Co., Philadelphia, Pa.—The company has announced the promotion of Wilson D. Trueblood, Jr., former sales engineer, to district manager of the office in Milwaukee; Edwin A. Yeo, former Cincinnati manager, becomes manager at Pittsburgh; and Willard H. Neu, former sales engineer, becomes district manager at Cincinnati.

Tinius Olsen Testing Machine Co., Willow Grove, Pa.—Appointment of the Research Instrument Co. as Ohio sales representative has been announced by the Tinius Olsen Testing Machine Co. With offices located at 12410 Triskett Rd., Cleveland, the Research Instrument Co. will handle the entire line of Olsen physical testing equipment for the State of Ohio with the exeeption of several counties adjacent to the Pittsburgh area.

Sun Chemical Corp., Long Island City N. Y.—Thomas J. Craig was appointed technical director of Sun Chemical Corp. and its subsidiaries, effective Jan. 1, 1954. According to Ralph C. Persons, president, this is another step in the Corporation's efforts to build an organization of specialists in every phase of its operations. Mr. Craig joined Sun Chemical Corp. in 1944 and has been general manager of the E. J. Kelly ink division.